

EXPOSURES



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A Journal of Exploratory Research and Analysis

The research articles published here represent the Capstone Research efforts of recent graduating seniors in the University Honors Program. The articles present projects conceived from personal academic interests and mentored by faculty who are familiar with the research and scholarship driving these efforts of discovery.

While the stirrings of personal interest are a crucial element in the cultivation of sound research practices, they should not be confused with the stirrings of sound research practices themselves. The stirrings of sound research emerge only from a special growth in perspective, and the goal of good mentoring is to awaken these stirrings and override the restrictive limits of personal interest and its attendant beliefs. We thank our faculty mentors, over a hundred so far, who have worked with our Capstone students over the past ten years to frame and conduct effective research projects.

In the process of acquiring new perspective in life, we need to cultivate new attunements, attitudes and convictions. But we also need to see how these orientations sensitize or desensitize us to the blind spots in our understanding. Are there not issues, concerns, opportunities and challenges relevant to our lives that we can only appreciate *from*

somewhere else? As we grow older in life, we are fortunate to discover new points of entry to our surrounding world, but only by closing off or eclipsing *other* points of entry.

To see the world in a new light, to acquire new *entries* to the world, is to listen more attentively and to become responsive in a new way. The capacity to respond to issues and concerns otherwise masked from view demands a special openness and attention to experiences we find strange and challenging. We seldom see the world in a new light without first having the curiosity and willingness to explore surprising, unexpected, easily marginalized phenomena -- nor without learning to discern otherwise hidden facets of our filtered social and personal constructions.

We trust this collection of articles will stir your interest in some timely topics. The goal of these writings is to increase awareness of what is actually at stake, integrate this into the formation of compelling research questions, present findings based on analysis of criticism and exploratory questions, and suggest how these findings might influence more positive developments. These articles reflect efforts to raise *curiosity* to the level of *sound research* with respect to topics and issues we hope will spark interest in the minds of our readers.



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Seniors in the Honors Program are encouraged to tackle complex problems using methods, insights and knowledge drawn from relevant disciplines. Honors Program faculty and capstone research mentors offer critical feedback and guidance along the way.

The main objective is for students to explore, gather, and analyze information effectively, and to share their reflections on the implications of what they have discovered. Group discussions help to promote thoughtful questioning and critical analysis. The primary goal is to communicate knowledge, judgments, and original perspective cultivated on the basis of careful inquiry, exploration and analysis.

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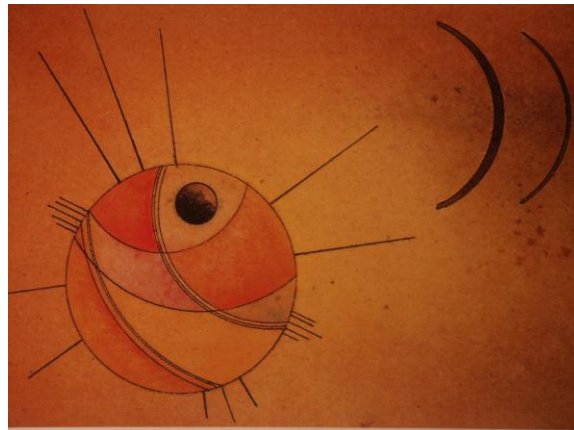
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HONORS PROGRAM COMMUNITY STATEMENT

The Honors Program at CSU Stanislaus is a community of scholars bound together by vital principles of academic openness, integrity, and respect. Through focused study and practice involving exploration and discovery across a variety of disciplines, the Honors Program upholds these principles of scholarly engagement and provides students with the necessary foundations for further research and inquiry.



Our interdisciplinary curriculum is integral to this work, and is intended to facilitate creative understanding of the irreducible complexities of contemporary life and knowledge. Personal and intellectual honesty and curiosity are essential to this process. So, too, is critical openness to difficult topics and respect for different perspectives, values and disciplines. The Honors Program aims to uphold these virtues in practice, in principle, and in community with one another.

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Characterization of MeCP2e1 Transgenic Mice

Charlene H. Emerson, Dag H. Yasui, Ph.D., Janine M. LaSalle, Ph.D.

Rett Syndrome (RTT), a neurodevelopmental disorder characterized by loss of speech and purposeful limb movement, seizures, breathing abnormalities, and often autistic features, is caused by mutations in methyl CpG binding protein 2 (MeCP2). In 2004, a second isoform of MeCP2, called MeCP2e1, was discovered. While MeCP2e1 appears to be the predominant isoform in the brains of both humans and mice, little is known about its biological function and importance.

To study the role of MeCP2e1 in neurodevelopment, transgenic mice with a mutant *Mecp2* exon 1 translational start site were generated, creating the first known mouse model with targeted deletion of *Mecp2e1*. Mice were phenotypically characterized using a panel of behavioral and motor function tests, as well as characterization by immuno-staining of *Mecp2e1* deficient and hemizygous control cerebral cortices. Results indicate that *Mecp2e1* knockout mice have a distinct phenotype which includes decreased anxiety and decreased sociability. Immuno-staining results appear to confirm the loss of *Mecp2e1* in the cortical brain tissue of *Mecp2e1* deficient mice. Study results show notable overlap with, as well as significant differences from, previous *Mecp2* mouse models, providing support that *Mecp2e1* transgenic mice may supply a useful and unique model for exploring RTT therapy.

INTRODUCTION

Mutations in *MECP2* leading to defects in methyl CpG binding protein 2 (MeCP2) account for the majority of Rett Syndrome cases (1). Rett Syndrome (RTT) is a both mice and humans (9). Like the previously studied MeCP2e2 isoform, MeCP2e1 possesses both a methyl DNA

neurodevelopmental disorder characterized by loss of speech and purposeful limb movement, seizures, breathing abnormalities, and often autistic features (2). An X-linked disorder, RTT primarily affects females, at an incidence of about 1 in 10,000-15,000 births. Patients develop normally for the first 6-18 months of life and then display regression of physical and cognitive development, including deceleration of head growth, loss of verbalization, and loss of purposeful hand movements followed by a period of stabilization (3). Since the protein MeCP2 is known to be involved in gene transcription and expression, abnormal epigenetic regulation is thought to be the underlying cause of RTT pathogenesis (1).

MeCP2 is a DNA-binding protein that preferentially binds methylated CpG dinucleotide regions of DNA (4, 5). *In vitro* studies have lent substantial support to the model of MeCP2 as a transcriptional repressor of methylated promoter regions (5, 6). However, continuing studies seem to suggest that the role of MeCP2 extends far beyond transcriptional repression (7, 8). After large-scale mapping of neuronal MeCP2 binding sites, it was found that more than half of promoters bound by MeCP2 are actively expressed (8). In another study, MeCP2 appeared to activate the majority of gene targets as well as associate with transcriptional activators (7).

To further complicate the study of MeCP2 function, a second isoform of the protein generated by alternative splicing was discovered in 2004 (9, 10). The new isoform, designated MeCP2e1, appears to be the predominant form in brain tissues of binding domain (MBD) and a transcriptional repression domain (TRD) (11). These features point to the role of MeCP2 as a transcriptional

repressor of gene expression. However, MeCP2e1 possesses a unique amino terminus distinct from the MeCP2e2 form due to alternative splicing (9). The MeCP2e1 amino terminus may confer unique biological properties to its isoform. Discerning these distinctive properties which may eventually reveal the biological function of each isoform in brain and other tissues (9, 12). Differences in MeCP2 isoform function may also explain variation in neurodevelopmental phenotypes associated with mutations in MeCP2e1 or MeCP2e2 (13, 14). Variants in exon 1 of *MECP2*, which is present only in MeCP2e1, have been linked to mental retardation and developmental delay (13). *MECP2* Exon 1 mutations also seem to be associated with a more severe RTT phenotype (14).

Given its predominance in the brain, identifying the biologic function of MeCP2e1 should be relevant to RTT and other disorders. Notably, compared to MeCP2e2, MeCP2e1 is more similar to analogous forms of the protein in lower organisms, including zebrafish and frog (9), suggesting that MeCP2e1 is the ancestral form of the protein. As the older protein form, MeCP2e1 may function in a more fundamental and dramatic role than MeCP2e2. Additionally, mice deficient in both isoforms of MeCP2 were only partially cured of neurological symptoms when MeCP2e2 expression was re-introduced (15), further suggesting a vital role for MeCP2e1 in the brain. Taking these findings into consideration, it is hypothesized that MeCP2e1 is relevant to RTT pathogenesis and normal brain development.

To study the role of MeCP2e1 in neurodevelopment, transgenic mice with a mutant *Mecp2* exon 1 translational start site were generated. It is predicted that these mice will have a number of physical and neurological features in common with existing *Mecp2* deletion mouse models of RTT. Mice will be subject to behavioral and motor function tests, as well as

characterization for the loss of MeCP2e1 by immuno-fluorescent staining. It is expected that the transgenic mice will lack expression of MeCP2e1, while expression levels of MeCP2e2 will be comparable to wild-type mice littermates.

If a mouse model lacking MeCP2e1 is successfully generated, there will be significant implications for future MeCP2 research. The role of MeCP2e1 in normal development may shed light on the isoform's contribution to RTT and other autism-spectrum disorders. This information may someday be used to develop therapies for patients with RTT and similar neurological conditions.

METHODS

Mouse Phenotyping

Mice were scored according to a "Sickness" scoring system with one point assigned for each trait observed in the mouse, including hind limb claspings, forelimb washing, matted fur, skin lesions, absence of curling, body deformity, and reduced ambulation. Hind limb claspings, the retraction and curling of hind paws, and forelimb washing, a repetitive circular motion of the forelimbs, are behaviors only seen in *Mecp2* knockout mice. Matted fur was defined as tufting of the fur that occurs when mice stop grooming. Skin lesions were raw areas of skin resulting from over-grooming. Matted fur and skin lesions could occur on the same mouse. Absence of curling was tested by picking the mouse up by the tail and noting whether the mouse curled its body upward and side to side in escape efforts. Body deformity was defined as a shortening or fattening of the mouse body compared to normal mice. Reduced ambulation was characterized by an observable lack of movement around the cage by the mouse. Scores were averaged and compared weekly for MeCP2e1 deficient males (hemizygous), *Mecp2* females carrying one mutated copy of *Mecp2* (heterozygous) and wild-type females. The Elevated Plus

Maze and Social Novelty Test were performed as previously described (16, 17). Ataxia was assayed by Treadscan (CleverSys Inc, Reston, VA), according to manufacturer's instructions.

Histology

Intact brains were removed from *Mecp2e1* transgenic mice and wild-type littermates at 6-10 weeks, fixed for 72 hours in 4% formaldehyde, washed with 1XPBS and dehydrated in 70% ethanol prior to paraffin embedding and sectioning by microtome as previously described (18).

Immuno-fluorescent (IF) Staining

5.0 micron tissue sections were processed and stained with the *Mecp2e1* custom antibodies JLN (Aves Inc, Tigard OR), CSN (non-commercial source), and MEN8 (Sigma-Aldrich, St Louis, MO) diluted at 1:100 to 1:200 in immuno-fluorescent (IF) stain buffer [phosphate buffered saline (PBS), 1% fetal calf serum (FCS), and 0.5% Tween-20] as described previously (19). Primary antibodies were incubated on slides for 18 hours at 37°C, and then washed five times in PBS/0.5% Tween-20 for five minutes with shaking. Secondary antibodies, including Alexa 488-goat anti-chicken antibody and Alexa 594-goat anti-mouse antibody (Molecular Probes), were diluted 1:100 in IF staining buffer and incubated on slides for 2 hours at 37°C. Five washes with shaking in PBS/0.5% Tween-20 for five minutes followed. Slides were mounted in Vectashield (Vector Laboratories) containing 5µg/ml DAPI, coverslipped, and sealed with nail polish.

Fluorescent Microscopy and Imaging

Slides were viewed with a 100x oil immersion objective on a Zeiss Axioplan 2 (Carl Zeiss, Thornwood, NY) fluorescence microscope equipped with a Retiga EXi high-speed uncooled digital camera (QImaging, Surrey, BC, Canada), fluorescent filter sets, and automated xyz stage controls. A Macintosh

computer running iVision (Scanalytics, Vienna, VA, USA) software with Multiprobe, Zeissmover and 3D extensions was used for acquiring and processing slide images. Blue, green, and red filters were used to visualize fluorescence. Images were merged using the same iVision software to create a representative image of total fluorescence. All images were taken in real-time preview mode using a 100x oil objective with a 1x zoom. Each image set used the same exposure times, microscope settings and image processing settings for optimal visual clarity. Slides were not blinded prior to image analysis.

RESULTS

***Mecp2e1* knockout mice have a distinct phenotype.**

To evaluate the phenotype of the *Mecp2e1* transgenic mice, a panel of behavioral and motor function tests was used. The Elevated Plus Maze, Ataxia (Treadscan) Screening, and Social Novelty Test were chosen based on their appropriateness in previous studies with transgenic mice (20). These tests were also chosen because they each assay for characteristics of the Rett Syndrome phenotype in humans (16, 20). In addition to these tests, a "Sickness" scoring system was used to score overall fitness and health in *Mecp2e1* deficient and hemizygous males along with heterozygous and wild-type females.

The Elevated Plus Maze (EPM) measures anxiety in mice using a maze assay. In the maze, which is elevated 40-70 cm above a surface, anxiety is measured by comparing the amount of time spent in the open arms of the maze with time spent in arms covered by sidewalls (17). Mice with higher levels of anxiety are believed to spend more time in the arms with sidewalls, while less anxious mice generally spend more time in the open arms of the maze (17). To control for activity, the number of entries into the closed and open arms is scored simultaneously. In this test,

Mecp2e1 deficient males spent more time in the open maze arms, suggesting that they are less anxious than wild-type littermates. This did not appear to be the result of overall hyperactivity or faster movements by Mecp2e1 deficient mice based on measurements of total distance traveled by mice. Additionally, no significant difference between Mecp2e1 deficient and hemizygous male mice was observed in Ataxia Screening, which measures abnormal locomotion. Similar Ataxia Screening results between Mecp2e1 deficient and hemizygous male littermates further suggest that the results of the EPM are due to differences in anxiety between littermates, not differences in motor function. Taken together, these results indicate lower levels of anxiety in Mecp2e1 deficient mice, contrary to previous findings with total *Mecp2* exon 3 and 4 knockout mice (20).

Measurements of sociability were assayed by the social novelty test. In this paradigm, the test mouse is placed into the center of an enclosure with 3 compartments. After an acclimation period, an object mouse is placed in a neighboring transparent compartment. An additional mouse is later placed in another transparent compartment. A video tracking system records the time that the test mouse spends in each compartment socializing with the object mice (16). When compared to hemizygous control littermates, Mecp2e1 deficient mice spent more time in an empty compartment than with stranger mice, indicating lower sociability. These results were unexpected given the previous studies of social behavior in *Mecp2* exon 3 and 4 knockout mice (20).

A “Sickness” scoring system was developed to account for abnormal phenotypic features, including hind limb clasping, forelimb washing, and reduced curling in response to tail suspension along with the presence of matted fur, skin lesions, gross body deformity, and reduced

ambulation. For each abnormal characteristic that a mouse exhibited, one point was assigned. In this assay Mecp2e1 deficient and hemizygous control littermates were observed and scored weekly. By 9 weeks postnatal, Mecp2e1 deficient mice had an average score of 2.875, which was significantly higher ($p > 0.0011$) on the “Sickness” scoring system than hemizygous male littermates, which had an average score of zero. Mecp2e1 deficient mice also had significantly higher ($p > 0.0465$) “Sickness” scores than heterozygous females, which averaged 0.143. These results suggest that a total loss of MeCP2e1 expression in males is more detrimental to health than the loss of a single Mecp2e1 allele in females that have two alleles.

Mecp2e1 expression appears to be absent in Mecp2e1 knockout mice.

Immuno-fluorescent staining and microscopic analyses were used to qualitatively compare Mecp2e1 and Mecp2e2 expression in cortices of *Mecp2e1* knockout and hemizygous control cerebral cortices. 5.0 micron coronal cross-sections from 11 week old mice were immunostained with CSN and JLN antibodies for Mecp2e1 detection and with MEN8 antibodies for combined Mecp2e1 and Mecp2e2 detection. Because MEN8 staining of neurons is specific for both Mecp2 isoforms, expression of Mecp2e2 was used to compare relative levels of JLN and CSN staining for Mecp2e1. Nuclei and heterochromatic chromocenters were visualized by DAPI staining.

As no commercial antibodies exist for MeCP2e1 detection, both CSN and JLN antibodies were custom made in chicken for the purpose of MeCP2e1 detection. However, designing MeCP2e1 specific antibodies is difficult due to the repetitive amino acid sequence encoded by *MeCP2* exon 1. Nonetheless, the CSN antibody was designed to target amino acids encoded by exon 1 of *MECP2* with some amino acids derived from exon 3 to provide diversity. Similarly, JLN

was designed to target amino acids from exons 1 and 3, with the majority of amino acids from exon 1. Recognition of *Mecp2* exon 1 amino acids is expected to make CSN and JLN antibodies specific for Mecp2e1; however, because each antibody targets slightly different amino acid sequences, it is possible that different immuno-staining patterns would be observed for each antibody. The MEN8 antibody is a commercial product that targets both Mecp2 isoforms as it targets common amino acids from *Mecp2* exon 3.

As expected, immuno-staining with CSN and MEN8 together in control hemizygous mice revealed CSN fluorescence in the nucleoplasm of cortical neurons. Neuronal chromocenters also showed CSN fluorescence in control mice; however, these signals appeared predominantly in the nucleoplasm, similar to previous findings (19). This staining pattern suggests that expression of Mecp2e1 is found primarily in neuronal nucleoplasm as well as in neuronal chromocenters. Also consistent with previous findings, MEN8 staining in hemizygous control mice showed strong fluorescent signals in the heterochromatic chromocenters and nucleoplasm of cortical neurons. Together, these results reaffirm the previous hypotheses that total Mecp2 expression is localized to chromocenters and nucleoplasm, while Mecp2e1 is mainly expressed in the nucleoplasm (19).

Immuno-staining of Mecp2e1 knockout mice with both CSN and MEN8 antibodies revealed an overall reduction in fluorescent signal in the nucleoplasm and chromocenters of cortical neurons. This effect was most pronounced in the apparent absence of CSN signal in the nuclei of cortical neurons, indicating a lack of Mecp2e1 expression in knockout mice. MEN8 signal was still detectable in the neuronal chromocenters of Mecp2e1 knockout mice, but was much weaker than the signal seen in hemizygous control littermates. This reduction in signal is

consistent with the expectation that total Mecp2 fluorescent signal will be diminished in the absence of Mecp2e1. Lack of CSN fluorescence and reduced MEN8 fluorescence suggests that expression of Mecp2e1 is absent in knockout mice.

Although CSN and JLN are designed to preferentially recognize the Mecp2e1 isoform, immunostaining of Mecp2e1 deficient adult cortex suggests that JLN may recognize nuclear proteins other than Mecp2. Overall, combined JLN and MEN8 staining of adult cortex from hemizygous control mice was very similar to the staining patterns seen in CSN/MEN8 combination staining. Consistent with expectations of Mecp2e1 expression, fluorescent signals for JLN were seen mostly in the nucleoplasm, but also in the chromocenters of cortical neurons. As expected in the hemizygous control mice, MEN8 fluorescence was most apparent in neuronal chromocenters, but was also visible in nucleoplasm.

However, immunostaining results from JLN and MEN8 staining of knockout mice deviated from expectations in some key aspects. Unexpectedly, cortical neurons from Mecp2e1 deficient mice exhibited greater JLN fluorescence in the nucleoplasm than hemizygous littermates. This marked difference from CSN staining patterns is likely due to the difference in amino acid sequences used to make each antibody. MEN8 signals seen in combined JLN/MEN8 staining suggest that JLN may be binding to unknown proteins. Similar to the results seen in CSN/MEN8 staining, MEN8 fluorescence was reduced in knockout mice. This result indicates a reduction in total Mecp2 expression, consistent with a loss of Mecp2e1 expression. Results of MEN8 staining indicate a loss of expression of Mecp2e1 in knockout mice, with increased amounts of nonspecific binding by the JLN antibody.

DISCUSSION

Genetically engineered mice were developed to study the biological function of the protein isoform *Mecp2e1*. Behavioral studies, overall health and fitness assays, and immuno-fluorescent staining of brain cortex were performed on *Mecp2e1* deficient mice. Behavioral measures of anxiety revealed lower levels of anxiety in *Mecp2e1* knockouts, while sociability measures suggested decreased sociability. Phenotypic abnormalities were measured by a “Sickness” scoring system that assayed for abnormal traits including hind limb clasping, forelimb washing, reduced curling in response to suspension, along with matted fur, skin lesions, gross body deformity, and reduced ambulation. Results indicate that *MeCP2e1* deficient males suffered the greatest impact to overall health, while heterozygous females also showed higher “Sickness” levels. *MeCP2e1* wildtype females and hemizygous males did not have significant sickness scores.

Some phenotypic overlap exists between the *Mecp2e1* transgenic mice in this study with other transgenic mice lacking *Mecp2* expression, including mouse models of RTT (20-22). Unlike exon 3 and 4 knockout mice, *Mecp2e1* deficient mice showed anxiety levels lower than controls (20). This finding is discordant with several other studies, which show negligible differences in anxiety levels (21, 23). However, other mice models of Rett with a truncated form of *Mecp2* demonstrate increased levels of anxiety (22). These diverse findings indicate the complexity involved in expression of *Mecp2*, depending on the type of mutation involved. Also, the mice in this study are the first known targeted deletion of *Mecp2e1*. Thus, it is expected that there would be differences in the phenotype of novel *Mecp2e1* deficient mice compared to previous total *Mecp2* knockouts.

Delay before symptom onset was another feature found in both *Mecp2e1* deficient and

other *Mecp2* mouse models. Severe neurological symptoms were observed in *Mecp2* exon 3 and 4 knockout mice at 6 weeks postnatal (20). Similarly, the “Sickness” score, which may indicate neurological defects, became markedly increased in knockout mice compared to wild-type littermates and heterozygous females at 6 weeks postnatal. Like the total *Mecp2* deficient mice, heterozygous females also exhibited symptoms of neurological defect. However, the “Sickness” score of *Mecp2e1* heterozygous females was significantly lower than that of male knockouts. Previous heterozygous female models of RTT showed their most severe symptoms at 12 weeks postnatal (20). However, *Mecp2e1* deficient mice have only been scored until 9 weeks of age; therefore, comparisons of later developmental dates will be included in future work.

Immuno-staining performed on the cortical brain tissue of *Mecp2e1* deficient mice suggests that expression of *Mecp2e1* is absent in the transgenic mice. CSN, an antibody designed to be specific to *MeCP2e1*, did not produce specific signal above background in *Mecp2e1* deficient mice. Because CSN was created based primarily on amino acids derived from exon 1 of *Mecp2*, which is only present in *MeCP2e1*, and some sequence from exon 3, these results suggest that *Mecp2e1* is absent in the *Mecp2e1* transgenic mice. MEN8, an antibody targeted for both *MeCP2e1* and *MeCP2e2* isoforms, had lower intensity signals in *Mecp2e1* deficient mice, consistent with the expectation that the total *Mecp2* levels would be less in *Mecp2e1* knockout mice. Interestingly, JLN, an antibody designed to be specific to *MeCP2e1*, showed a higher level of nuclear fluorescent signal in *Mecp2e1* deficient mice. Since JLN was created using amino acids from exon 3 and some from exon 1, it is not surprising that the staining patterns would differ from CSN antibody staining results.

Because JLN staining contradicts staining patterns from both CSN and MEN8, it is believed that the increased fluorescence is a characteristic of nonspecific JLN antibody staining, not as the result of specific binding to Mecp2e1.

To clarify the results found in this study, future work will include immuno-staining with an MeCP2e2 specific antibody, as well as Western blotting with the same JLN, CSN, and MEN8 antibodies to quantify amounts of each isoform. MeCP2e2 specific antibodies would allow levels of Mecp2 to be directly observed, rather than inferring expression levels from the MEN8 antibody staining,

which recognizes total *Mecp2* expression. Western blotting will provide a more quantitative analysis of expression levels of each Mecp2 isoform and confirm results found in the immuno-staining portion of the study. Results of this study show notable overlap with previous studies of Mecp2 knockout mice as well as interesting differences that may eventually illuminate the biological function of the MeCP2e1 isoform. It is hoped that in the future, these novel Mecp2e1 knockout mice may provide a useful model, separate from total MeCP2 knockouts, for exploring Rett Syndrome therapy.

TABLES AND FIGURES

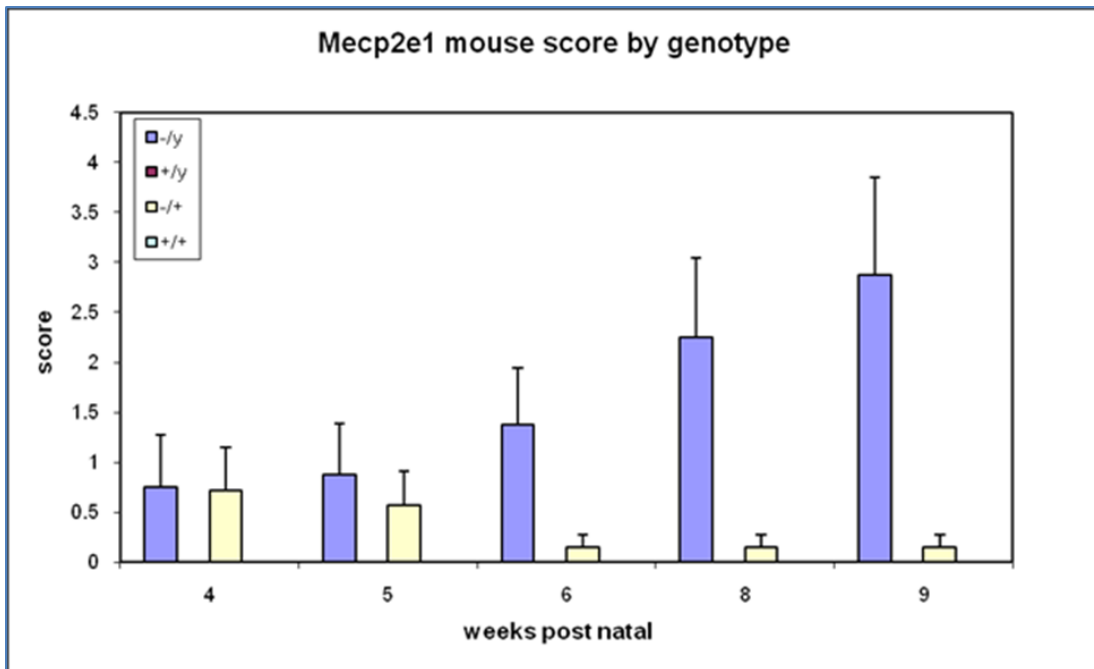


Fig.1 MeCp2e1 knockout mice scored significantly higher on a “Sickness” scale than hemizygous male and wild-type female littermates. The “Sickness” score for knockouts increased from 4 weeks postnatal to 9 weeks postnatal, eventually reaching 2.875, compared to wild-type and hemizygous littermates with scores of 0. MeCP2e1 heterozygous females also scored higher than all littermates besides knockout males. However, “Sickness” scores for heterozygous females decreased by 9 weeks postnatal, stabilizing with a score of 0.143.

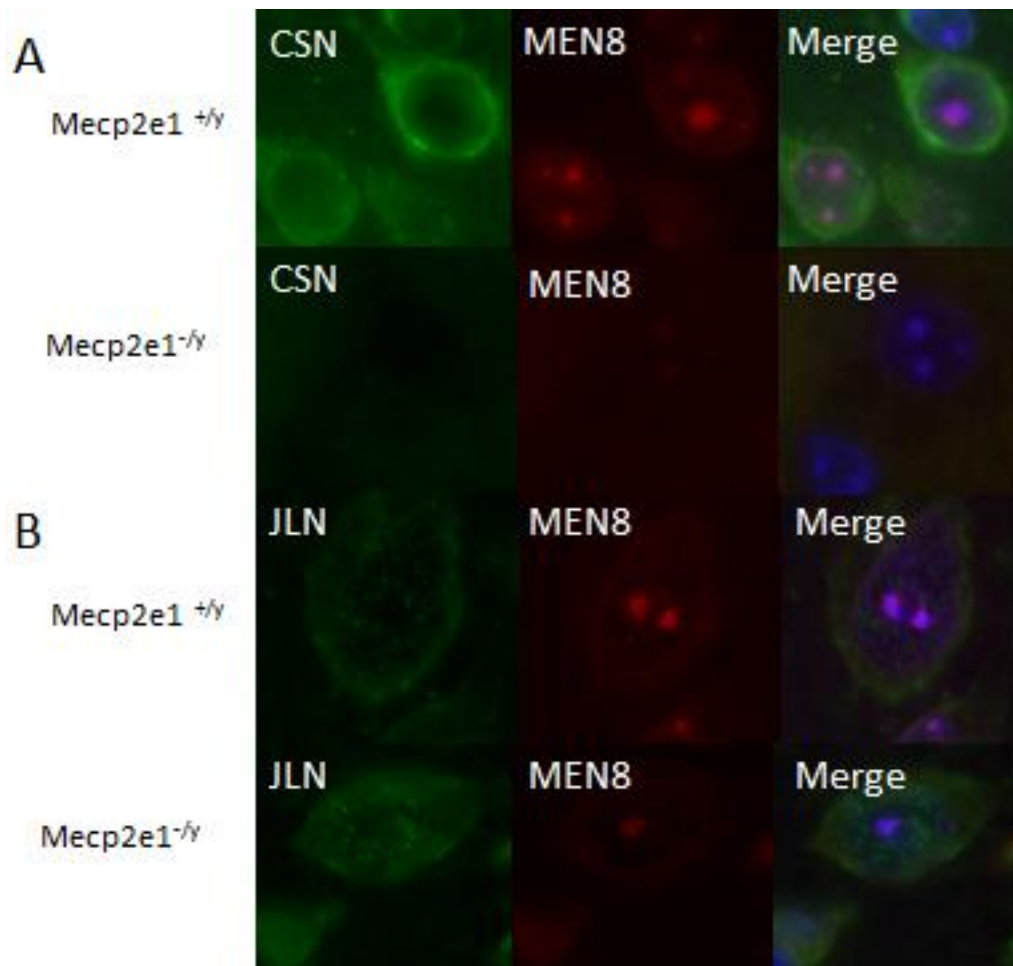


Fig.2 Loss of MeCP2e1 resulted in less MeCP2e1 specific staining in the cortical neurons of mice. A) CSN, an MeCP2e1 specific antibody, showed an absence of staining in knockout mice. MEN8, an antibody specific for both isoforms of MeCP2, showed a lower amount of fluorescence, consistent with expectations. B) JLN, an antibody designed for MeCP2e1 specificity, showed increased amounts of staining in knockout mice. However, MEN8 staining is still reduced in knockouts, indicating an absence of MeCP2e1 expression.

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Photosynthetic Variation and Biomass Allocation in Buffalo Gourds (*Cucurbita foetidissima*)

Karolyn Hamlin

INTRODUCTION

During the summer months when the weather is hot and dry, many plants try to conserve energy and water by reducing photosynthesis and growth. *Cucurbita foetidissima*, or the buffalo gourd, is notably different in that it keeps growing rapidly throughout the summer. Despite this apparent absence of water, it produces a huge taproot. The hypothesis of this study is that *C. foetidissima* will exhibit a correlation between root size and photosynthesis rates. This is because water is needed for photosynthesis, and a plant with a large root will be able to store more water and therefore have a greater photosynthetic rate. Potential genetic variation among populations of buffalo gourd will also be examined for the purposes of data analysis.

BACKGROUND TERMS AND CONCEPTS

Form Fits Function

That form fits function is a fundamental axiom of biology. Form is considered a characteristic of an organism, while a function is the role filled by form. This experiment explores the hypothesis that the large taproot of the buffalo gourd fulfills the function of storing water for use in photosynthesis. Research on this topic is warranted because of the peculiar drought-resistant nature of *C. foetidissima*. Because it behaves differently than other plants, there must exist some mechanism that allows it to do so. A correlation between high photosynthesis rates and large root size is expected to explain this phenomenon, particularly if there does not appear to be genetic variation among the samples. This would show that the persistent

growth of this plant in drought conditions is connected to its ability to grow a large tap root.

C. foetidissima

Cucurbita foetidissima is a gourd from the squash genus of the cucumber family distributed across the United States and Mexico. It has many colloquial names, including the buffalo squash and the Missouri squash (USDA National Plant Data Center). *C. foetidissima*, a drought-resistant perennial plant, has been known to live for upwards of forty years. The roots are large, pale taproots with distinctive ridges and have been known to reach 70 kilograms in weight. These roots are interesting not only because of their size, but also because they only grow a few feet into the soil then turn sharply to run parallel to the surface. The plants regularly exhibit these traits, even in areas where the ground below three or four feet has the same consistency as above. This indicates a hereditary influence in the distinctive shaping of these roots. Indeed, these traits affect the drought-resistant qualities of *C. foetidissima*. Though their roots do not reach deep enough to take advantage of underground water tables, the extensive root system nearer to the surface takes advantage of water from rainfall and runoff (Knapp and Fahnestock 1990, Dittmer and Talley 2011).

RELATED RESEARCH

Research covering biomass allocation or genetic variation of *C. foetidissima* populations specifically is not readily available. However, trait variation in plant populations is a well-founded researched topic. Photosynthetic rates, transpiration rates, and biomass allocation are common variables in inquiries relating to genetic variability

within a species. In a 2001 article by Diane L. Rowland, gas exchange rates were one of the factors used in examining genetic variation across populations of North American riparian cottonwood. The rates were similar, but consistent differences were found. More conclusively was a study by Geber and Dawson (2011) in which photosynthetic rates were correlated to other traits (stomatal conductance in particular) in order to demonstrate significant differences between populations of *Polygonum arenastrum*. The importance of considering genetic variation in this research comes from the fact that *C. foetidissima* is found in many regions with dry but varied environments. If the presence of large tap roots relates to high photosynthetic rates, will this be consistent across all populations and show little genetic diversity in that trait?

Photosynthesis and Transpiration

Photosynthesis is the process by which plants and other organisms convert water and carbon dioxide into sugar while releasing oxygen with the use of sunlight. This sugar is used as building material for the plant so that it may grow. This reaction takes place inside the plant's chloroplasts, which are organelles and give plants their green color. Water is obtained from the ground through the plant's roots while carbon dioxide must be obtained from the atmosphere. Small pores, usually on the undersides of leaves, called stomata are responsible for this. As the pores open, they are able to intake carbon dioxide for photosynthesis. However, a trade-off must be made. As the pores open and allow carbon

dioxide to come in, they are also allowing water to escape. This process of water loss is called transpiration. The less water that escapes while bringing in carbon dioxide, the more water use efficient the plant is said to be. Higher water use efficiency means better water retention per carbon dioxide unit acquired, which makes for a more drought-tolerant plant.

IRGA (Infrared Gas Analyzer)

The infrared gas analyzer is a device that measures the carbon dioxide intake of a particular leaf of a plant as well as that leaf's output of water (transpiration). The model used was a closed path IRGA LI 6400 from the company Li-Cor. The equipment has two main components: a handheld clamp called the sensor head and an attached computer. The clamp is designed to hold the live leaf between two cushioned plates that form a chamber but do not damage it. A predetermined concentration of carbon dioxide gas is pumped into the chamber, and infrared sensors in the clamp detect the change in concentration as the remaining gas is pumped out. The change in carbon dioxide concentration indicates the rate of photosynthesis, which is calculated by the attached computer component. In addition, the device also detects the amount of water released by the plant, yielding data on the plant's water efficiency. (The IRGA removes atmospheric water in the air before pumping it into the chamber in order to take measurements from a controlled starting point.)

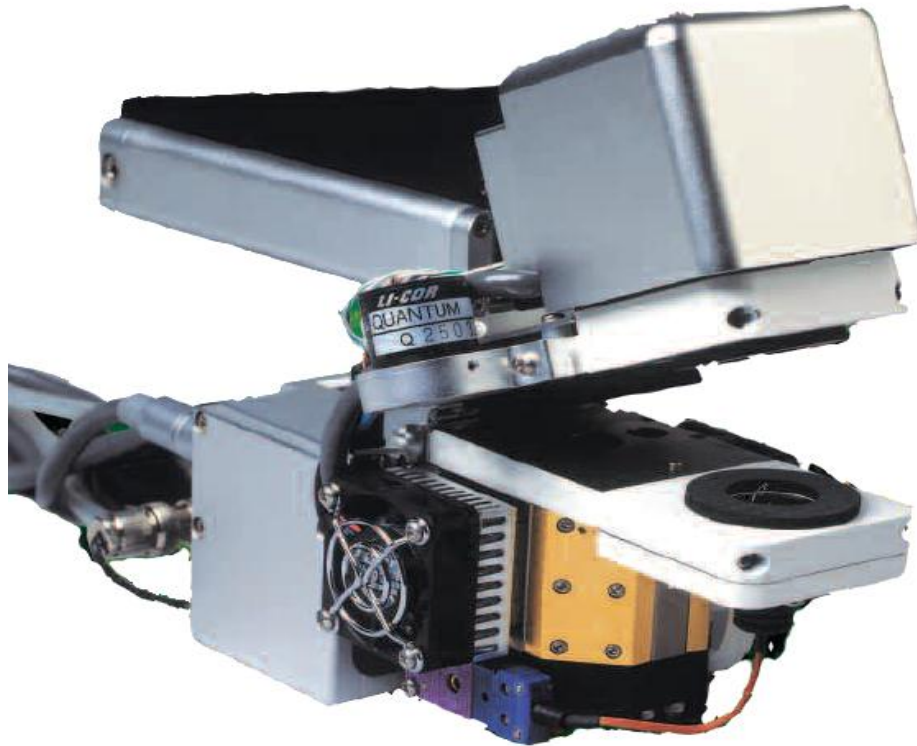
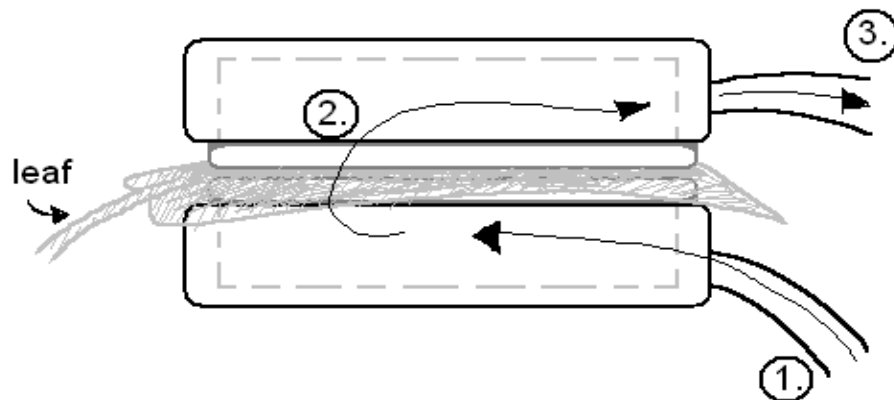


Fig. 1: A photograph of a sensor head similar to the one used in the experiment. The padded chamber where the leaf is placed can be seen. *Image from Licor.com*



1. Carbon dioxide flows in
2. Photosynthesis and transpiration occur in chamber with leaf
3. Oxygen, water, and excess carbon dioxide flow out

Fig. 2: A simplified drawing of the sensor head of the infrared gas analyzer. This demonstrates the flow of gas to be analyzed.

Biomass Allocation

Biomass allocation refers to the where the growth of an organism occurs. The growth of *C. foetidissima* was partitioned into two main categories for this experiment: the shoots and the roots. The shoots consisted of the above ground, green portions of the plants, including the leaves and vines. The roots are the below ground portion where water and starch are stored. Examining the shoot mass to root mass ratio gives insight into how the plants are utilizing their energy. Are they focusing on building up reserves in their roots (ratio <1), constructing more leaves to increase photosynthesis and reproduction (ratio >1), or spending their energy equally between the two (ratio = 1)? If there are differences among the individual plants, is there a correlation between high photosynthetic rates and growth either above ground or below?

METHODS OF DATA ANALYSIS

Set-up

Several specimens of *C. foetidissima* were collected from locations in Utah, Arizona, and California. They were planted in two plots in a common garden in the California State University Stanislaus Biology Field Site. The purpose of a common garden is to rule out environmental factors in the development of plants, leaving variations among them to genetic sources (Moloney et al.). Eight of the plants were analyzed, four from each plot. Plot B had plants from Riverside, CA and Waterford, CA, while Plot A had plants from Utah, Arizona, and other places in California. In order to check if the plots are consistent with each other, the data collected from each plot will be compared using ANOVA ('analysis of variance', a type of statistical analysis). This will account for variables such as differences in soil consistency. The gourds were not watered over the summer of 2011 in order to simulate drought conditions. Watering resumed in the fall of 2011.

Photosynthesis and Transpiration Measurements

Two types of leaf were analyzed per plant, and the data was averaged. One leaf was an older one nearer to the root, and the other was a newer leaf towards the end of a vine. Leaves with dried patches of dead cells were avoided, as well as leaves too small to fill the chamber. Measurements were taken over the summer of 2011 during drought conditions as well as in the fall when the plants were watered.

Biomass Allocation

The shoots and roots of the eight plants were collected. The shoots were clipped from the roots and stored in labeled paper sacks. Care was taken not to crush and therefore lose portions of the drier leaves. Once the shoots were clipped away, the number of branches protruding from the roots were counted and recorded on the paper bags. Next, the roots were excavated. Again, care was taken not to break the finer fibers in order to retrieve as much of the root as possible. The roots were also stored in labeled paper bags. The masses of the roots were taken before being dried. This measurement is recorded so that when the roots are dried again, the amount of water stored in them can be determined.

PROJECTED RESULTS

Because the buffalo gourd is a very drought-resistant plant, I am expecting that a significant portion of the weight in the roots will be from wet mass (water weight) as opposed to dry mass (plant matter). From what I saw of the plants when digging them up, there did not seem to be much distinction between the plants in the two plots. However, there was variation among all of the plants in root size. Lengths of the roots ranged from less than a foot to over a yard, and it is yet to be seen if there is a correlation between root size, photosynthesis rates, or point of origin.

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Effects of Metacognitive Therapy on Schizophrenia, and Possible Improvements

Julia N. Valentin

Imagine yourself projected into this scenario:

It's a cold, gloomy day. You peek out of your apartment window through the blinds to make sure everything is safe before you exit the building to go to work. Everything seems to be fine, so you venture out of your apartment deliberately, but cautiously. However, in the back of your mind, you have a strong, overpowering feeling that someone is watching you. As you walk down the street, you hear footsteps behind you. You quicken your pace. The footsteps quicken as well. You break out in a run towards a more crowded street. When you get to the street, you quickly glance behind you to see who was following you. No one is to be found. With a shiver down your spine, you continue on.

When you get to work, you can hear your co-workers talking about you. They are conspiring against you to try to get you fired by telling your boss that you're always late to work and not fulfilling the required duties. They are always whispering behind your back, and you can always hear their negative comments playing over and over in your head. They say things such as, "You are not going to last another month in this job" or "You are a total failure." Although you try to explain to your boss what's going on, you are unable to make the words come out properly.

It becomes even worse when you go to the grocery store after work. Passing by each aisle, people turn to look at you apprehensively. When people see you, they quickly turn and walk the other way. You can hear their voices echoing throughout your head saying, "We need to get away from you before you curse us with your mere presence!" or "Who would even want to look at you, you complete failure!" Their voices seem to overpower you and become louder and so intense that you run out of the store and back to your apartment where you sit in your house,

unable to move, trying to evade the voices echoing in your head.

This experience is not at all pleasant. It would be terrifying and stressful, to say the least. The scenario just presented is an example of what life might be like for one who has untreated schizophrenia. Because of the severity of these untreated symptoms in some people, it is imperative they be provided with highly effective treatment with effects that are long lasting. A treatment plan using regular cognitive behavioral therapy (CBT) sessions and supplemented by metacognitive training (MCT), in addition to regularly taken anti-psychotic medications, might prove to be the most effective treatment regimen for schizophrenia. While MCT is effective in helping clients cope with their delusions, it fails to address a very significant component of schizophrenia experienced by some people: auditory hallucinations. In order to understand why and how CBT and MCT treatment plans work, and where they are deficient, one needs to acquire some background knowledge about schizophrenia and the development of CBT and MCT treatment protocols.

LITERATURE REVIEW

Schizophrenia affects about 1% of the population worldwide (Williamson, 2006). The DSM-IV (2000) is currently utilized in diagnosing the disorder. While many aspects of the disorder can be lessened or eliminated by taking antipsychotics, other methods, such as Cognitive Behavioral Therapy (CBT) and, most recently, Metacognitive Therapy (MCT), are being studied as comparable alternatives or supplements to these medications. CBT can provide skills to those who are resistant to taking medication and help improve everyday struggles for

people with schizophrenia such as having trouble at work and developing relationships with others (Morrison, 2009). In 2010, psychologists in the United States and Great Britain were surveyed to gather their views on CBT in relation to schizophrenia to determine their views regarding the efficaciousness of this fairly new treatment (Kuller, Ott, Goisman, Wainwright & Rabin, 2010). The UK rated CBT the best treatment for schizophrenia, while the United States rated medicine the best form of treatment. This difference, as the article stated, could be due to the differences in the types of health services offered in both countries. Clinical trials testing Cognitive Behavioral Group Therapy (CBGT) have also been introduced in past studies (Lawrence, Bradshaw, Mairs, 2006).

Metacognitive Training (MCT) is a more recent treatment developed to treat schizophrenia. Metacognitive Training (MCT), a new treatment for schizophrenia developed by Steffen Moritz and Todd Woodward, can help people with schizophrenia to become more attuned to illogical thinking patterns associated with their illness (Woodward 2009). A variation of CBT, this approach targets positive symptoms, delusions in particular (Kumar et. al., 2010). Since then, a review of the current findings in MCT has been written (Moritz, Vitzthum, Randjbar, Veckenstedt, & Woodward). The article concludes that MCT can now be seen as a complement to regular therapy sessions. Testing this idea, a recent study conducted in 2011 in France proved that MCT is a method of treatment well received by the clients it serves (Favrod, Maire, Bardy, Pernier & Bonsack, 2011). MCT was also seen in this study to further clients' knowledge, understanding and response to delusions.

SCHIZOPHRENIA

While each person experiences schizophrenia differently, there are a few

specific universal characteristics that define it. However, not all of these characteristics have to be present in a person for them to be diagnosed with schizophrenia. According to the DSM IV, two or more of the following characteristics need to be present in order for a diagnosis of schizophrenia to be made: delusions, hallucinations, disorganized speech, grossly disorganized or catatonic behavior, and negative symptoms such as a flat affect. These symptoms usually appear during adolescence or early adulthood for males with a possible extension by a few years in females (DSM IV, 2000). Delusions are false beliefs accompanied by strong convictions despite obvious disapproval by evidence. Thus, in the previously described scenario, the delusions would be that the person believed he or she was being followed and watched, conspired against at work, and hated by everyone in the grocery store. Therefore, despite the fact that a simultaneous occurrence of these events is not probable and also regardless of anyone telling him or her different, the person experiencing this scenario would most likely continue to believe this was happening to him or her. It is difficult to convince someone that what he or she had just experienced was not real because it was extremely real to him or her. Hallucinations, on the other hand, are false/ distorted sensory experiences that seem to be real. Auditory hallucinations, or illusory perception of sound/ voices, are the primary type of hallucinations experienced by those with schizophrenia. Contrary to common conceptions, visual hallucinations are relatively rare. Disorganized speech patterns occur because the person has disorganized thought patterns. These disorganized thought patterns can manifest themselves in speech patterns as well. A person with schizophrenia may have trouble communicating with others because his or her speech patterns can be jumbled or in

some cases, unrecognizable. In the scenario previously presented in the introduction, the person had difficulty communicating with her boss. Another possible symptom of schizophrenia, grossly disorganized behavior, is when the given behavior is inappropriate for the setting in which it occurs. An example of this could be exhibiting sexual behavior that is not appropriate in a public setting. Catatonic behavior, in comparison, can involve either the inability to move or respond to outside stimuli or behavior that is strangely hyperactive. This was represented in the introductory scenario toward the end in which the person was faced with the inability to move. Lastly, those with schizophrenia can experience blunted affect, which is characterized by one's inability to have emotional reactions. Blunted affect can often be seen in one's facial expressions. Out of all these symptoms associated with schizophrenia, the most common and perhaps one of the most difficult to overcome are delusions. New advancements in treatment have been found to heighten understanding and decrease the effect that delusions can have on those with schizophrenia.

COGNITIVE BEHAVIORAL THERAPY

Discussed by Aaron Beck in 1952 but not fully realized until quite recently was the use of Cognitive Behavioral Therapy (CBT) in the treatment of people with schizophrenia. The approach first became widely accepted in Britain where clinical trials were and are conducted on a regular basis. The United States did not do as much research to start out with because of the differences in medical services offered. Britain has the National Health Service that guides the mental health programs, while the United States is made up of many private practices that have some flexibility in how they approach treatment (Kuller, Ott, Goisman,

Wainwright & Rabin, 2010). Those who study CBT believe that "Cognitive behavioral therapy is based on the idea that our thoughts cause our feelings and behaviors, not external things, like people, situations, and events" (NACBT, 2010). Also, CBT promotes the idea that anyone can change his or her behavior to cognitively, not always realistically, make the situation better. There are many techniques practiced in CBT. Attention switching, attention narrowing, increased activity levels, social engagement and disengagement, modification of self-statements, and internal dialogue are some commonly used techniques in CBT (Tarrier & Haddock, 2004). The following is a CBT scenario: a client with schizophrenia goes to see a therapist who practices CBT because he is convinced that his neighbors are plotting to kidnap and kill him. A therapist who practices CBT would go about helping the client by allowing him to look at the situation with a reasoning point of view. Some questions such as "Why would these people be plotting to kill you?" or "Does this seem probable?" would probably be asked to further examine this delusion the client is having. The client would work closely with the therapist to figure out what is really going on and why what they are thinking is irrational. Eventually, the client will be able to catch negative feelings that he or she has and challenge these with logic instead of merely responding out of fear or emotion. CBT has also been tested in groups with schizophrenia, but primarily in Britain and not the United States. However, the competency of therapists who usually practiced CBT alone with the client and not with a group came into question. A newer variation of CBT, called MCT, has now been introduced by Steffen Moritz and Todd Woodward. This type of treatment specifically targets the delusions that are among the main symptoms of schizophrenia.

METACOGNITIVE THERAPY

Metacognitive Training (MCT) is the most recent method developed to help people with schizophrenia learn to deal with the delusions they may experience. It is the best approach to treating schizophrenia when supplemented by regular visits to a therapist and, depending on client preference, medication as well. MCT is conducted mostly in group settings, which is much more cost effective and able to help a larger number of people with schizophrenia. One of the main things that makes MCT different and perhaps better than CBT is the fact that the therapy sessions are conducted in a group setting. Group settings have been shown to help clients develop a means of support, something which is often weak or non-existent in their life. This could be caused by a lack of family or friends because of the disease. Since many people with schizophrenia experience delusions often resulting in distrust of certain individuals, this can lead him or her to estrange themselves from others. So assuming, people with schizophrenia may have a difficult time forming relationships outside of therapy. Interacting with others in a group setting where trust can be built and experiences can be shared yields exceedingly positive results. In MCT, the group is taken through training sessions extending over a certain number of weeks, depending on the frequency of meetings. During these sessions, the therapist or therapists working with the clients present the following core subjects: attribution, jumping to conclusions, changing beliefs, theory of mind, memory, self-esteem and mood. These subjects are separated into sections called modules. Each module addresses one of these common illogical thinking patterns and goes through exercises that can help clients to avoid them. The modules are presented in ways that are easy to understand and interactive. The clients are

encouraged to talk about these patterns of thinking and consider their own experiences relative to the patterns of thinking. Being presented in a group setting allows clients to feel less pressure than being one-on-one with a therapist and helps them understand that they are not the only one who feels a certain way and experiences schizophrenic symptoms. The sessions also are fun and entertaining for clients because they show pictures to illustrate how common misconceptions of thought can occur. For example, the jumping to conclusions module uses a card trick to show clients how people can automatically believe that the card trick is not just a trick, but "magic." Therefore, MCT is very new, but extremely promising.

The only downfall associated with MCT is that it primarily addresses delusions; it does not address auditory hallucinations in much depth. While medication can lessen this symptom or eliminate it altogether, what is it like for people who do not wish to take medication? Some cultures and religions even guard against the use of medications or prohibit it. These are ethical considerations one must note when working with people of various cultures and ethnic backgrounds. Specific training targeting hallucinations could make a large impact in cases like this. Medication can also produce unwanted symptoms that are not favorable to some clients. For example, clozapine, a regularly prescribed drug for some patients with schizophrenia can have negative effects on the immune system. Various people who have taken clozapine for schizophrenic symptoms have suffered decreased immunity. This could definitely be an unwanted side effect that could result in many serious problems. Other antipsychotic drugs can cause publicly uncomfortable symptoms such as Tardive Dyskinesia, or unintentionally repeated movements of the body or face.

Since MCT is already being tested and producing positive results for delusions, can't something be done to help clients with the auditory hallucinations they might experience? Although there is no real cure to make hallucinations go away, there could be another component added to MCT to make it more effective in targeting the auditory hallucinations as well as the delusions. Apart from cultural or personal preference to not take medication to treat schizophrenic symptoms, there are other factors to consider. Medication availability could be a large factor as well. What if someone were unable to get a prescription for his or her medication on time due to personal or financial reasons or forgot the medication and didn't have immediate access to it at the precise time it was needed? A program that clearly addressed hallucinations would be extremely beneficial to anyone with schizophrenia who experienced hallucinations in case one of these things were to happen. Auditory hallucinations, when a person has false auditory perceptions, are very common to schizophrenia. People with schizophrenia often report how auditory hallucinations are like voices in their head telling them to do things. Some people have even said that the voices tell them to hurt or kill themselves. People with schizophrenia have occasionally

followed the instructions of their voices as well, which could be as minor as opening a window or as serious as committing suicide. If this is the case, auditory hallucinations should definitely be addressed in these MCT sessions and not ignored. While delusions are important to address in the sessions as well, there should be an addition to these sessions that discusses auditory hallucinations. A possible solution to this problem would be to implement a module into the MCT therapy that primarily provides psycho-education about hallucinations and steps to get through them if they happen to occur. This would definitely be something to explore more in depth to find other possible solutions.

Since MCT is a fairly new practice, there are not many articles discussing potential deficiencies in its practice. Many articles only define MCT and talk about its practices. Others merely give accounts of the successes of MCT during various clinical trials. The approach outlined here makes the claim that although there are many positive applications of MCT, there are some components that can be improved. Hopefully, this concept can be expanded upon in the future by suggesting possible detailed implementations that can be used to address hallucinations in future MCT sessions for clients with schizophrenia.

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Criminal Compositions

Rebekah Nelson

Every great innovation in art has been received with resistance. One of the first reviews of Claude Monet's work compared the pieces, which are arguably among the most universally beloved works of art ever produced, to an unfinished sketch for wallpaper and *found it lacking*.¹ This unfortunate recurring distaste for progressive art has left no movement unscathed. But the global graffiti art movement has felt the wrath of skeptics more keenly than any movement that has emerged before. Uninformed observers see graffiti works as nothing more than delinquent vandalism that attacks family values and creates unsafe environments. Frank Fouchalk, a security expert and contributing writer for the New York Post states, "Graffiti is like a contagious disease; if left untreated, it will only spread." He goes on to affirm that "[graffiti's] only goal is to degrade the business community."² This statement exemplifies the unfortunate assumptions held by many who, blinded by their lack of knowledge, see only the crime and not the art. Some skeptics cite gang-related graffiti as support for their claim that

graffiti is inherently harmful. While there is no denying that there are links between some forms of graffiti and gangs, the relationship is not causal. Graffiti does not create gangs. Graffiti is a diverse and powerful medium, with the potential to connect to the masses in ways that are simply unachievable to most forms traditional art. Graffiti is the transcendence of high art from the sterile confines of the art gallery into a direct, unadulterated and unfiltered union with the viewer made more meaningful by its ephemeral nature.

Its creators often function as social and political commentators while utilizing traditional artistic devices in new venues. The commentaries of graffiti artists are one of the many common threads that weave between graffiti and what is accepted as high art. Other stylistic similarities between specific examples of fine art and examples of graffiti works will be discussed at length. To facilitate that discussion, some vocabulary must be clarified:

The different types of graffiti are created by individuals, or writers, but also by groups, typically called crews, which function as artistic communities with a deep sense of camaraderie.³ Graffiti, like all art, is comprised of works of varying degrees of sophistication and technique. It is important to note that while graffiti as a whole has the potential to be high art, the subgenres of tagging and throw-ups typically do not possess the technical merit or artistic intention that would validate their inclusion in the category of high art. Graffiti works can be

¹ In a famous remark, art critic Louis Leroy has offered the following response to Monet's *Impression: soleil levant*: "Impression I was certain of it. I was just telling myself that, since I was impressed, there had to be some impression in it — and what freedom, what ease of workmanship! A preliminary drawing for a wallpaper pattern is more finished than this seascape."

The review was printed April 25, 1874 in *Le Charivari*; the art movement took its name from the above statement. http://en.wikipedia.org/wiki/Louis_Leroy

² Fouchalk, Frank. Security. Troy: Jan 2008. Vol. 45, Iss. 1; pg. 14, 2 pgs.

<http://proquest.umi.com.ezproxy.lib.csustan.edu:2048/pqdlink?Ver=1&Exp=12-02->

2016&FMT=7&DID=1412658791&RQT=309&clientId=17873#indexing

³ Grody, Steve. Graffiti L.A.: Street Styles and Art. New York: Abrams, 2006. Print.

loosely organized into three main categories:



Figure 1

Tags consist of quick one color text-based designs, like figure 1⁴. They often state the artist name and/or crew affiliations. This is the type of graffiti preferred by gang writers for marking territory boundaries. These rapidly executed signatures typically would not be considered a high art form. As the anonymous graffiti writer U in Mark Halsey and Alison Young's article '*Our desires are ungovernable*' : *Writing graffiti in urban space* states, "I'd say the actual tagging part of graffiti is just downright vandalism. It has no art or beauty to it." Authors Halsey and Young go on to explain that "such views are generally consistent with ways in which writers defined 'graffiti,' separating 'art' (piecing) from 'vandalism' (tagging) and 'artists' (or writers) from 'taggers,' 'bombers' and 'vandals.'"⁵



Figure 2

4

http://www.graffitibegone.us/images/graffiti_lamp_post_before.jpg

⁵ Halsey, Mark, Young, Alison. 'Our desires are ungovernable' : *Writing graffiti in urban space. Theoretical Criminology*. 2006. Pg. 275

tags, throw-ups, and pieces.

Throw-ups are also generally texted-based designs commonly notifying the viewer of the artist and possibly the crew to which the writer belongs but are executed in two to three colors. Classic throw-ups are composed of a silver fill with black outlining, such as the one pictured in figure 2⁶, but palettes vary artist to artist depending on preference and availability of paint. This type of graffiti generally lacks the sophistication of form and content⁷ to be considered fine art.



Figure 3

Pieces, an abbreviation of the term masterpiece, constitute the category in which graffiti achieves its high art standing. Pieces are complex and diverse; they consist of numerous hues depicting infinitely varied subject matter that generally take entire crews to accomplish. Pieces can be text-based or figurative, often featuring caricatures of individuals or fanciful creatures.⁸ Pieces can be purely freehanded, painted without stencils or the use of photos, as pictured in figure 3, as well as feature a combination of techniques.

6

http://aeroghost.blogspot.com/2005_01_23_archive.html

⁷ Form refers to what the piece of art is- the medium, the stylistic devices, etc. Content is the message of the work- what the artist is attempting to convey to the viewer.

⁸ Grody, Steve. *Graffiti L.A.: Street Styles and Art*. New York: Abrams, 2006.



Figure 4

Stencils are used frequently to produce sophisticated images very quickly. The famous artist known as Banksy is best known for his stencil pieces such as the fox⁹ depicted in figure 4; wheat-pasted images on paper are also used for the same reason. The most renowned wheat-paster is artist Shepard Fairey, creator of the OBEY art works and subsequent brand. His most notable motif, the stylized face of Andre the Giant, is portrayed in image 5.¹⁰



Figure 5

Pieces are not confined to the wall; there is also a sub-genre of graffiti in which the artists produce three dimensional and often interactive works.



Figure 6

The piece pictured in image 6 by artist Joshua Allen Harris was created using plastic trash bags. The creatures are inflated and given life by the air currents that pulse through the city's sidewalk grates from the subway moving below.¹¹ Then the creatures slowly deflate- symbolically dying, as the subway moves on. His charming creations warn of the dangers of global warming in a unique, approachable way that appeals to passing children and adults alike.

Harris uses the gentle charm and child-like wonder his creatures evoke to discuss his ecological commentary. Artists Banksy and Shepard Fairey both tend to use sarcasm and humor that has a habit of being rather coarse to discuss their ideas. The work of Banksy typically draws attention to the injustices of capitalism as well as the issues of surveillance. Fairey's work explores the way in which repetition of an image gives it power. The messages of graffiti artists are as unique as the people who create them. What is essential to note is the directness with which their messages are delivered. The decisive advantage graffiti has over traditional fine art is that it avoids the filtering that occurs when art is placed in a gallery. Art galleries create barriers—physical, psychological, and social—between the viewer and the art works. The physical barriers are blatant; one typically cannot physically interact with the art; galleries post signs and frequently have guards preventing the public from fully engaging with the work. The psychological barriers are more subtle. Art galleries have a tendency to feel sterile, almost hospital like, resplendent in pristine white walls, attended by personnel who speak in hushed tones as though in a funeral home. As owner of Detroit art gallery Art Effect confesses in a recent interview, “I believe that commercial art galleries feel very cold and unapproachable in general. I never feel dressed-up enough, that I’m talking softly

⁹

http://lh4.ggpht.com/_9F9_RUESS2E/SsTOPfi6b5I/AAAAAABQY/M8qsiRdemew/s800/banksy-graffiti-street-art-kentuckyfox.jpg

¹⁰ <http://twistedifter.com/2010/04/awesome-street-art-by-best-ever/>

¹¹ <http://www.dtail.com/category/sculpture/page/5/>

enough, and that I have enough money in my wallet to justify crossing the thresholds of most galleries.”¹² Art galleries have an unfortunate tendency of draining the vitality and approachability out of the work that is housed in them. The work is ripped from the creative environment of its birth and stagnates, hindered by its context that is bereft of the energy with which it was formed. In stark comparison, graffiti exists eternally within the moment of its creation; its vitality is untouched by artificial constructs and continuously replenished by new artists’ contributions and even the weather. The most intriguing aspect of this dynamic is that to most viewers this lack of a traditional art context, the gallery, which is graffiti’s most powerful characteristic, is the main reason they find difficulty accepting it as art. The Christian teen website Creation Tips proclaims, “that is the problem with graffiti — it is ‘unauthorized’, as the dictionary says, and it destroys someone’s property.”¹³ To them the issue is not that the work lacks the virtuosity and sophistication found in the masters of art, it is that is outside, unsolicite



Figure 7

¹² Thedetroiter.com. Detroit Gallery Week Spotlight: Art Effect Detroit. 2011.

<http://www.thedetroiter.com/v3/2011/10/detroit-gallery-week-spotlight-art-effect-detroit/>

¹³ Graffiti: Vandalism posing as art? 2009.

<http://www.creationtips.com/graffiti.html>

Graffiti artists draw on the same wealth of artistic knowledge as traditional artists; the work of British graffiti duo Best Ever¹⁴ blends loose expressive gestural movements that function to flatten the picture plane with photorealistic areas of the human form in a style similarly employed by Renaissance mastermind Leonardo Da Vinci.¹⁵



Figure 8

Both bodies of work define forms utilizing chiaroscuro, the soft gradual transition from light to dark, to model the face. Both artists also intentionally leave parts of the compositions in apparently unfinished states, creating works more visually stimulating than if the artists had rendered the imagery entirely. The blending of loose, sketchy regions with highly realistic elements creates a dynamic push and pull between the illusionistic and the intentionally flat areas of the picture plan that engrosses the viewer

¹⁴ <http://twistedstifer.com/2010/04/awesome-street-art-by-best-ever/>

¹⁵

<http://www.ibiblio.org/wm/paint/auth/vinci/sketch/theadjman.jpg>



Figure 9

In the very large composition displayed in figure 9¹⁶ by the Montreal-based crew known as A'shop, the Art Nouveau artist Alphonse Mucha is referenced extensively.¹⁷ A'shop samples Mucha's compartmentalist formatting featuring a large female figure set against decorative floral motifs as well as the quintessential whiplash curves the art movement is famous for. A'shop's composition also employs a color palette similar to that of most of Mucha's work. A key difference between the graffiti work and the work by Mucha is that interspersed with the typical floral and harvest imagery this modern work depicts the city in which it resides. This inclusion of local imagery

¹⁶

<http://www.mymodernmet.com/profiles/blogs/massive-art-nouveau-inspired-mural-in-montreal>

¹⁷

http://www.joieart.net/artwork/spotlights/mucha_champagne.jpg

creates a stronger resonance with the viewers; it gives them something concrete to connect with.



Figure 10

Purely text-based pieces can also reference great works.



Figure 11

Artist Greg Paragrighoriou of Athens creates text based pieces¹⁸ that reference classic Arabic calligraphy art such as the tile piece from the 1635 AD Wazir Khan Mosque¹⁹ pictured in figure 12.



Figure 12

Paragrighoriou employs the same elegant interlocking lettering as the great masters of calligraphy to create forms.



Figure 13

¹⁸ <http://twistedifter.com/2011/04/calligraffiti-by-greg-papagrighoriou-25-pics/>

¹⁹ http://en.wikipedia.org/wiki/File:Arabic_Calligraphy_at_Wazir_Khan_Mosque2.jpg

Graffiti can incorporate existing art as well as reference it; the simple minimalistic piece shown in figure 13²⁰ becomes a part of the bronze statue when lit at night, creating a dynamic installation piece out of a rather common sculpture. Part of the magic of graffiti is its ability to shift one's perception of the world- often by simply a small addition of paint.

The pieces mentioned are a minuscule sample of the varied and vibrant world of graffiti. But even from such a small sample as this, one can plainly see the connections between what is accepted as art and graffiti; it becomes clear that graffiti is indeed a new facet of art. Galleries have begun to recognize this and are even beginning to feature premier graffiti artists (this relocation in the gallery space begs the question- can graffiti remain such when it is placed in such an unusual venue?). The art culture is slowly finding a place for graffiti amongst the accepted mediums, but the general population, those who make up majority of graffiti's target audience, are continuing to be resistant. This is partially caused by the prevalence of the notion that graffiti is only a pastime of criminals bent on disturbing the peace. This, quite simply, is not the case. Graffiti artists come from all walks of life, drawn together by a shared love of the art form and often a desire to beautify the buildings upon which they paint.

The piece by A'shop, mentioned previously, is an example of the crew's efforts to beautify the old building. It was the crew's goal to transform the building from an eyesore to a focal point of the community. In an interview A'shop artist Kris Wilk discusses the project: "the idea was to step out of our comfort zone and show the public what graffiti artists can be capable of. There is an amazing amount of quality work being produced within Montreal's graffiti scene. Unfortunately, bad press and political

²⁰ <http://www.streetartutopia.com/?p=2014>

strategies often only show the ‘negative’ side of it, creating unneeded friction between citizens and our culture. Graffiti as a form of visual language can be hard to comprehend for most. We thought it would be interesting to paint this mural in a more common language, using imagery that anyone can understand, initiating dialogue and building bridges.”²¹ The point Wilk makes about graffiti being difficult to understand is also typically a factor in why most people fail to see it as art. How can one appreciate a great work of art if one doesn’t understand the language it is create in? The problem with this is that most viewers do not pursue any knowledge to help them contextualize and understand the piece. They simply dismiss it as vandalism. This attitude is what must change. The public is depriving themselves of a beautiful, as well as free and widely accessible, art form by refusing to broaden their artistic horizons.

21

<http://www.mymodernmet.com/profiles/blogs/massive-art-nouveau-inspired-mural-in-montreal>

Greeks and Prestige: On the Relationship Between Fraternity and Sorority Membership and Future Occupational Attainment

Danielle Fletcher

INTRODUCTION

“All but two of the US Presidents, since 1825 have been Greek” (Researchers at East Carolina University, 2011). Information like this is widely available in recruitment materials for Greek Life. The purpose behind such statistics is promotional in nature and therefore the objectivity has to be questioned. As many of us know, statistics can be manipulated and this knowledge leads to the suspicious nature we lend to statistics associated with marketing materials. However, as will be exemplified more in the “Literature Review” section, there is a wide-listing of well-known Greek alumni. The availability of famous alumni leads to the question if there really is a correlation with fraternal organizations and some positive attribute of its members. The other possibility is that promotional statistics and anecdotal information causes this association between fraternal membership and fame. The next question would be why this matters. The influence of prestigious people, such as senators and national presidents, is far-reaching. If there is a high correlation between fraternal membership organizations and prestigious people then the effects of Greek membership is important for not just those involved in Greek Life but also for the many people they will later influence. This question is important in relation to future questions such as whether more people should be interested in the developmental and value effects of Greek Life and whether more people should be involved in deciding what programs and focuses those member organizations adopt.

‘Prestige’ is defined as “reputation or influence arising from success, achievement, rank, or other favorable attributes”

(Dictionary.com). Occupational prestige is the characteristic of influence associated with a career. Furthermore, occupational prestige can be measured and has been coded by the US Bureau of Census and the General Social Survey (G.S.S, 2009). As careers are highly associated with a person and occupational prestige is a more objective measure than personal fame and has a larger applicability, this study will adopt the question of whether there is a correlation between fraternal organization members and high occupational prestige. Furthermore, for clarification purposes, the terms “Greek Life,” “fraternal organizations,” and “fraternal membership organizations” will be used interchangeably to refer to the type of organizations named ‘fraternities’ and ‘sororities’ in modern culture.

LITERATURE REVIEW

Overall, the research into fraternal organization effects is limited. The literature delves deeply into the aspects of the relationship between fraternal organization members and alcohol as well as a great deal of literature on stereotypes and risky behavior. There is a limited amount of scientifically authoritative research on the effects of membership and the development of those members. Less objective information is available on the internet, especially from the websites of fraternities and sororities, on how the groups help members develop. This information takes the form of mainly anecdotal and program information. There seems to be a definite lack of research in determining the actual effects of membership on members, and this research is even more limited in consideration of long-term effects such as

careers. In essence, it appears that the research of correlation between membership in fraternal organizations and occupational prestige will provide a valuable and unique perspective to this topic.

Research correlating fraternal organization membership with alcohol consumption is numerous in comparison to other studies of fraternal organizations. Two such published studies are "Alcohol behavior, risk perception, and fraternity and sorority membership" and "Fraternities, sororities, and binge drinking: Results from a national study of American colleges" (Tampke 1990; Wechsler, Kuh, Davenport 1996). There is extensive research into correlating alcohol consumption and other risky behaviors with fraternal organization membership. Some of this research does show a higher correlation (Wechsler, Kuh, Davenport 1996). Although this research has little relevance to occupational prestige scores, it is relevant in implying an additional area of effect on members. If both alcohol consumption and occupational prestige have a positive correlation with fraternal organizational membership, then further research should be done on long-term effects of fraternal organizations on the members and how these effects may affect the members' future areas of influence.

There is a large amount of evidence on the internet, especially in promotional materials, about the fame of fraternal organization alumni. It is important to note that the fraternal organizations consider its alumni as continuing members, although no longer collegiate members. Examples of fraternal membership organizations promoting prestige of alumni can be found on organizational specific websites, such as the "Sisters of Distinction" section of the website for the CSU Stanislaus chapter of Alpha Xi Delta National Women's Fraternity. An additional example is university websites under the student affairs

departments such as that of East Carolina University. Names listed under the Alpha Xi Delta chapter site include fashion designer Betsey Johnson, entertainment name Jane Henson, and even astronauts ("Sisters of distinction"). Statistics from the East Carolina University include the propensity of United States Presidents to have been Greek affiliated, as well as Supreme Court Justices, Fortune 500 Executives, and again astronauts (Researchers at East Carolina University 2011). The exact statements of the site on these prestigious mentions are "All but two of the US Presidents, since 1825 have been Greek," "40% of all Supreme Court Justices have been Greek," "30% of Fortune 500 Executives are Greek," and "All of the Apollo 11 astronauts were Greek" (Researchers at East Carolina University 2011). The promotion of such prestigious figures is commonplace in recruitment and promotional fraternity organization materials and is important for the need of this research question and its development.

There is some research into the effects of fraternal organization membership on the developing collegians. Two examples of works examining the development of fraternity organization members are Hunt & Rentz's study *Greek-letter social group members' involvement and psychological development* (1994), and Asel, Seifert, and Pascarella's study *Effects of Greek affiliation on college experiences and outcomes: A portrait of complexity* (2009). The first study by Hunt and Rentz concluded that those involved in fraternities or sororities had an increased involvement level in their university and an increased motivation senior year toward completing the college degree (Hunt, Rentz 1994). Furthermore, the study reported an increased level of personal development garnered through their fraternal organization experience. In accordance with this

increased personal development was a clarified individual purpose. This study is one often cited by those involved in the discussion of fraternities and sororities as evidence of positive effects from fraternal organization membership, one example of which is the next study by Asel, et al (2009). Asel, Seirfert, and Pascallera added further research to the discussion of fraternal membership organizations with their survey of over 3000 collegian respondents (Asel, Seirfert, & Pascarella, 2009). The Asel study did not find a significant difference between fraternal organization members and non-members and academic engagement; however, the results did show that seniors reported a positive relation between affiliation and “the quality and impact of personal relationships with peers and student affairs professionals” (Asel, Seirfert, & Pascarella, 2009). Overall, these studies are relevant in reviewing the impact fraternal membership organizations have on collegians. The positive developments reported could supply some reasons for why there may be a correlation between occupational prestige scores and membership.

One study that did look into what may affect student’s future occupation was by Austin (1993). This study concluded that fraternity or sorority members had an increased likelihood of choosing a career in business or law (Austin 1993). In addition, involvement in fraternal organizations had significantly positive influences on students’ career relevant skills, such as leadership skills, public speaking abilities, and ability to influence others (Austin 1993). This study seems to directly support a correlation between occupational prestige and fraternal membership organizations. The age of the study and its brevity in regards to the career and influence limit its value, although its relevance is greater than other studies found.

Overall, after reviewing the limits of research in the subject matter of fraternal organization membership and its result on members, it can be concluded that the correlation between Fraternity Organization membership and prestige occupations will provide valuable and unique information in this area. In the future there may be more research on what are the affects of fraternities and sororities on their alumni members, the development of the collegiate members, and on society through their membership influence. Lastly, if a correlation is found between fraternal organization membership and occupational prestige, then, to fully value and understand this correlation, research will need to be done on whether it is the membership that causes the prestige or if those who will attain future occupation prestige are more likely to be interested in fraternal organization membership. Overall, if prestige is correlated with fraternal membership, then the affects of fraternal organizations may go beyond members and their development to influence those with whom the alumni membership has influence.

METHODS

This study will test the relationship between Membership in Fraternity Organizations with Occupational Prestige using regression analysis through the SDA and GSS Berkeley Computer-assisted Survey Methods Program. This research study will utilize a computer program hosted and developed by the Computer-assisted Survey Methods Program (CSM) of the University of California, Berkeley. The program is Survey Documentation and Analysis, or SDA, and it has the functionality to perform many different types of analysis, including multiple regression analysis. This study will utilize SDA and its multiple regression analysis function. Furthermore, the SDA has the ability to access the data and results of two

major National surveys: the General Social Survey and the American National Elections Survey. The General Social Survey (GSS) is a current and ongoing survey project of the National Opinion Research Center (NORC). Furthermore, the GSS is the dataset that will be analyzed for this research paper.

The stated purpose of the GSS is “to gather data on contemporary American society in order to monitor and explain trends and constants in attitudes, behaviors, and attributes... and to make high-quality data easily accessible to scholars, students, policy-makers, and others, with minimal cost and waiting” (Suter). This stated purpose is in line with the purpose of this research investigation and does not appear to have any inherent biases. The GSS has been a regularly undertaken personal interview national survey since 1971. The GSS was an annual survey until 1994 and has been biennial since. Also, in 1984 GSS became a part of the International Social Survey Program (ISSP) which allows cross-national data to be compared. According to NORC, “Except for U.S. Census Data, the GSS is the most frequently analyzed source of information in the social sciences” (Suter).

There are additional benefits of the General Social Survey that make it a good match for utilizing in this research study and strengthen it as a social science survey. One strength is the publication of the exact questions of the survey as well as possible answer choices. These are available for viewing to further educate the researcher about potential biases and implications of the questions. Furthermore, additional information is available such as a summary of respondent demographics, and weights are an option for viewing survey results if one demographic group was over-represented in respondents. The GSS data also provides the number of valid cases corresponding to specific questions. Also, as an ongoing project, there is access to the

data and results of every year since the project began. One aspect that limits the utilization of the yearly data for trends analysis is that the questions of the GSS are not all uniform per each year; part of the question base is changed yearly based upon areas of interest and need in the social sciences.

When utilizing the data set gathered by a survey set outside of the author, it is important to understand the affiliations, values, and purpose of the organization that sponsored the survey, which in this case is the National Opinion Research Center (NORC), the sponsor of the GSS. NORC is an independent, not-for-profit academic research organization affiliated with the University of Chicago. NORC has been an ongoing research center since 1940. NORC’s mission “is to conduct high-quality social science research in the public interest” (NORC). Furthermore, NORC is involved in projects with many associations and esteemed companies as listed and available on their website. With the wealth of information available on NORC and as the GSS is NORC’s longest running project, it appears that the GSS is a valid and esteemed data set.

Approach to Analysis

The data of the GSS will be analyzed using regression analysis to determine if there is a statistically significant relationship between fraternity membership and occupational prestige score. Regression analysis will be completed using the SDA, and statistical significance will be determined by a t-score above the absolute value of 1.95. The independent variable within this analysis will be membership in school fraternity, while the dependent variable will be occupational prestige and organizational position. In addition, to try to account for and remove the effects of the respondent’s family and socioeconomic class, as that has the

potential to be statistically significant as well, the fathers' occupational prestige score will also be set as an independent variable so as to serve as a control variable. This is being done to reduce the potential for omitted variable bias and improve the integrity of the results.

Variables

Fraternal Organization Membership.

The independent variable "Membership in School Fraternity" is defined as "MEMGREEK" in the GSS database. For asking respondents if they are fraternal organization members, the following statement is read: "We would like to know something about the groups or organizations to which individuals belong. Here is a list of various organizations. Could you tell me whether or not you are a member of each type." The respondent is then asked a list of organizations. For MEMGREEK, this list consists of "school fraternities or sororities." For MEMGREEK, the potential answers were coded: "Yes" (1), "No" (2), "Don't Know," "No Answer," and "Not Applicable" were all coded as missing variables.

Occupational Prestige. Occupational prestige is the first of two measures of occupational attainment. This variable was measured using the GSS variable "PRESTIGE." The variables incorporating an occupational prestige score were based on the US Bureau of the Census three digit occupation classification for 1970 or 1980 occupations. The three questions asked were the following: "What kind of work do you (did you normally) do? That is, what (is/was) your job called?", "What (do/did) you actually do in that job? Tell me, what (are/were) some your main duties?", and "What kind of place (do/did) you work for?" From this set of questions, the person giving the survey was trained to code the occupation. In coding the occupation, the GSS survey uses prestige scores determined

from a survey by Robert W. Hodge, Paul S. Siegel, and Peter H. Rossi (1963-1965) at NORC (G.S.S. 2009) . The 1989 Prestige scores were updated and prepared by Robert W. Hodge, Judith Traes, and Keiko Nakao (G.S.S. 2009). The website address of the entire codebook is available in the Bibliography if further information is desired (G.S.S. 2009).

Organizational Level. Occupational level is measured by the GSS variable "TOTSUP," which measures the total number of people who report to the respondent. This variable was chosen as a proxy of organizational level. The more people who report to an individual at work the higher the likely position held by this person in the organization. Each respondent was asked, "Counting all of these levels, how many people are responsible to you both directly and indirectly?" The interviewer then coded the numeric variable. The range of responses in the GSS varied from 1 to 2,211 people reporting to the respondent.

Father's Occupational Prestige. The respondent's father's prestige score is referred to as "PAPRES80." The father's occupational prestige was coded using the same method as occupational prestige "PRESTIGE." Both prestige scores were asked the aforementioned general occupational questions and then coded from the occupations to the prestige score as shown in Appendix A and explained in the GSS codebook. All of this was done by the trained surveyors. This variable was included as a control variable. The research evidence shows that members of fraternal organizations typically come from higher socio-economic status than non-members. For this reason, controlling for the socio-economic position of parents is critical for this analysis.

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History and Controversies of Capital Punishment

Kenny Sarisky

The words “death penalty” or “capital punishment” often bring out strongly emotional opinions. There are not many other issues that bring up this kind of emotion in people. After all, capital punishment has to do with people judging if a fellow person should live or die. But there is a lot more to the death penalty than just a simple right-or-wrong approach. Capital punishment has inspired argument related to its cost, purpose and method. From ancient times to present day, the death penalty has had an intricate and controversial history. This article will explain this history and present quick looks at some recent disputes surrounding capital punishment.

IN THE PAST

Ancient Civilizations

Many old civilizations included some use of the death penalty in their society. In the eighteenth century B.C., the Code of Hammurabi was created. Hammurabi was the king of the city of Babylon at the time, and his code consisted of 282 crimes and their punishments. The code uses *lex talionis*, the idea of “an eye for an eye”, and inflicts the death penalty for twenty-five of the crimes (Steffoff, 2008, p. 20). Ancient Egyptian civilizations around the twelfth century B.C. also used the death penalty. For example, those convicted of an assassination attempt on Pharaoh Ramses III were either put to death or forced into suicide. One harsh method of capital punishment was impalement with a stake, surely a slow and painful death (Dollinger, 2000). The first codified constitution of Athens, known as “Draconian Law” after the man that wrote it, was written in seventh century B.C. to make sure that everyone

knew what all the laws were. Capital punishment was more present than ever in Draconian Law; almost every crime, no matter how petty and harmless, was punishable by death (Ellis & Horne, 1913). The harshness of the code led citizens to say it was written in blood.

England: America’s Inspiration

The laws and civilizations stated above did not have as much of an effect of American death penalty as England did. Therefore, it would be helpful to look at how capital punishment developed and was viewed in England. The Middle Ages was a time of rampant executions in the country. Medieval England was ruled by a monarchy and the people demanded that the crown be swift and brutal in punishing criminals in order to serve the people he ruled. Since no police force or prison system comparable to today existed in the medieval times, a sentence of death was most commonly used. The people criticized officials when criminals were not executed quickly or often enough (McGlynn, 2008). Execution methods included boiling, burning at the stake, drawing and quartering, and hanging. Hanging in public was the most common method, and a public hanging reassured the law-abiding citizens that the government was protecting them by ridding the population of those who threatened social stability.

Determining the guilt of someone was usually done through trials. These trials, to the modern world, seem to have nothing to do with guilt or innocence. Instead of having a jury listen to facts and decide, the accused was assigned a task to perform and the result of that task would either exonerate him or implicate him. One such task was holding a burning rod of iron and then

having the hands bandaged for three days. If the hand wounds were infected after the three days, the person was deemed guilty (McGlynn, 2008). Trial by combat occurred when two parties had a dispute with no other witnesses. They fought each other with the idea that God would lead the innocent person to victory over the guilty person. Clergymen and nobles would often hire “champions” to fight in their place if they ever had to go through a trial by battle (McGlynn, 2008). These champions represented the person who hired him, and if the champion lost, the man he represented was guilty.

But in this time of medieval England, there were a few instances in which the public showed support for scaling back the frequency of the death penalty. In 1278, a man was killed for theft of four pence. The public response was critical over the seemingly harsh sentence for such a petty theft, and a new law was made setting twelve pence as the minimum for a death sentence. There was another instance in which a pregnant woman convicted of theft was not hanged because citizens felt such a punishment was unfair (McGlynn, 2008).

Coming To America

As America was colonized in the 1600s and 1700s, the laws put in place were very similar to those in England. This included the use of capital punishment but did not include all of the methods that the English government used. Out of all of those methods, the colonists viewed hanging as the most humane and used it the most (Bedau, 1997, p. 4). The hangings were still done in the public for all to see, and many people did come to watch. The number of offenses punishable by death in the colonies was, on average, twelve. In England, the number was much greater at around fifty (Costanzo, 1997, p.7).

The different states of the U.S. have different laws in place regarding capital

punishment. Similarly, laws about capital punishment differed depending on the colony. For example, the major Quaker colony of Pennsylvania did not particularly support a death sentence as much as other colonies. Their punishment views stressed reading the Bible and paying penance to God for their actions. Accordingly, Quaker colonies only assigned the death penalty to those convicted of murder or treason. North Carolina made both harboring slaves and inciting slaves to insurrection punishable by death. In Virginia, sentences sometimes depended on whether the offender was white or black. There were five capital crimes for white people and close to seventy for black people (Costanzo, 1997, p. 9).

Beccaria’s Influence in England and America

In 1764, Enlightenment thinker Cesare Beccaria wrote On Crimes and Punishments in which he called for the abolition of the death penalty. Until this time, a man dying for his crime was seen as just and no one had really spoken out against it. He stated that since man did not create himself, he did not have the right to destroy a life (Tuttle, 1961, p. 2). Beccaria expected to make enemies with his views but remarked that if he helped even one innocent man avoid death, that man’s gratitude would be worth making some enemies (Maestro, 1973, p. 464). Some took a liking to his views, such as England’s Jeremy Bentham and Sir Samuel Romilly and America’s Benjamin Rush.

Bentham was a theorist in the philosophy of law and had his thoughts about capital punishment affected by Beccaria’s arguments. It was the late eighteenth century when Bentham set forth his arguments about the death penalty and the public, once again, heard an opinion that differed from the status quo (Tuttle, 1961, p.3). Like Beccaria, he received heavy criticism and disagreement from the public.

Whereas the English citizens believed that death was the best punishment for a murderer, Bentham argued that one who takes the life of another would be more dismayed by solitary confinement, hard labor, and a long imprisonment (Tuttle, 1961, p.3). He also stated that once dead, there was no chance for rehabilitation for the criminal.

Romilly utilized the arguments of both Beccaria and Bentham to make changes to the English penal system in the early 1800s. Death was handed down as a sentence for many crimes, and Romilly saw a problem with that. In essence, he wanted England to have a justice system that was swift and more humane. In 1806, he joined the Parliament and got the death penalty removed as punishment for pick-pocketing in 1808. Also around this time, the Quakers formed a group that was willing to support Romilly's work against capital punishment (Tuttle, 1961, p.4). He led the charge for bills to get rid of the death penalty in cases of theft, believing that a lesser and more swift form of punishment would deter thieves. By the end of his life in 1818, Romilly had eliminated the death penalty as punishment for pick-pocketing, vagrancy by soldiers and sailors, and stealing from cloth makers (Tuttle, 1961, p.5). This was not very much, but as expected, he faced stiff opposition from others in Parliament.

Beccaria's words travelled across the Atlantic and hit the shores of America. Benjamin Rush took Beccaria's words to heart and delivered a speech in Philadelphia in 1787. Some influential Philadelphia citizens gathered at Ben Franklin's house to hear Rush argue against executions (Costanzo, 1997, p.9). Rush's stance was that the death penalty was an unlawful use of power by the state and was one of the earliest Americans who opposed it. He wrote a paper also calling for an end to the death penalty in America and relied on

Beccaria's abolitionist stance (Maestro, 1973, p. 466). With the support of those he persuaded, Rush's words led the Pennsylvania attorney general to propose the "degrees of murder" in 1793. Still in place today, the degree system distinguished different types of murder and made only "first degree" murder punishable by death. As mentioned above, Pennsylvania had a large Quaker presence, and this degree system was a sort of compromise between the abolitionist Quakers and people who wanted to keep capital punishment fully in place (Bedau, 1997, p. 4). Rush also preached against public executions, although this idea did not win over the public as much. Hangings, the preferred method of the time, could sometimes result in either the criminal slowly suffocating or being decapitated. But almost fifty years would pass before a state would end public executions. New York passed a law in 1835 that brought the hanging inside a prison yard or behind a wall out of view (Bedau, 1997, p. 5). The practice of lynching, an unofficial form of capital punishment, peaked during the late nineteenth century and continued into the early twentieth century (Banner, 2002, p. 229).

CAPITAL PUNISHMENT CASES

The United States Supreme Court has made many rulings that relate to the constitutionality and scope of the death penalty. Until 1962, the Court maintained that the Eighth Amendment of the Constitution, which says that no citizen shall endure cruel and unusual punishment, did not apply to the states. The Court therefore rejected state inmates' appeals since the Amendment did not apply to them. Even after the Court applied the Eighth Amendment to the states, the Justices ruled it was more about protecting against extreme punishments such as burning at the stake and crucifixion (Steiker, 1999, p. 126).

The late 1960s did not have many executions; it appeared that the United States was moving away from the use of capital punishment (Crew, 2001, p. 114). A decade later in the 1970s, two cases reached the Supreme Court that had a profound impact on capital punishment at the time and how it operates today. *Furman v. Georgia* was decided in 1972 and *Gregg v. Georgia* was decided in 1976. In a very short summary, the first case brought the enforcement of the death penalty to a halt, and the second case reinstated it. But that simple sentence does not give the necessary amount of attention to this important time in history.

William Furman, a poor, uneducated, mentally ill black man, was found guilty of murder and sentenced to death after only one day of jury deliberation (“Furman,” 2011). With the support of some death penalty opponents, Furman’s attorney got the U. S. Supreme Court to hear the case on the grounds that the jury’s broad discretion on whether to impose the death penalty was unconstitutional (Steffoff, 2008, p. 18). The appeal was based on the “cruel and unusual punishment” section of the Eighth Amendment. The argument was that such a serious sentence should be given only if a jury has been properly instructed and does not have too much discretion in the matter (Coenen, 2004). In cases that were similar, one jury might give the death penalty whereas the other jury might give a long prison sentence. At the time, poor minorities were far more likely to receive the death penalty as opposed to a middle-class white man. A study in 1941 revealed thirty-two percent of black defendants received a death sentence as opposed to thirteen percent of white defendants (Boger and Unah, 2001).

After deliberation, the Supreme Court handed down a ruling that stopped executions in the United States. The

decision of the Court did not find the death penalty itself to be unconstitutional, but rather said the way in which it was administered was “arbitrary and capricious.” Three justices, in their opinion, noted the lack of specific guidelines set forth allowed the jury to give the death penalty based on their own prejudices, which the Court considered cruel and unusual under the Eighth Amendment (“Furman,” 2011). Two concurring justices believed the death penalty was always cruel and unusual and went against the evolving standards of decency of the American people (Steiker, 1999, pp. 126-127). For the first time in American history, no execution could lawfully be carried out.

States attempted to revise their laws to meet the Court’s guidelines for capital punishment in order to legally enforce it again. Georgia did this by establishing a two-step trial for capital cases. Step one was a phase in which the defendant was either found guilty or not guilty of the crime. If the defendant was found guilty, he moved on to the second phase. The judge would instruct the jury about how they would decide if the death penalty was appropriate for the case. At least one aggravating factor would have to be present for the death penalty to be eligible, and they would be weighed against mitigating factors. Aggravating factors make the jury lean toward a harsh sentence while mitigating factors lead a jury toward a more lenient sentence. If the defendant is given the death penalty by the jury, the case would automatically be appealed to the state supreme court to make sure the sentence was not given arbitrarily (Crew, 2001, p. 117). This act of having a guilt phase and penalty phase is also known as a “bifurcated trial” and is still used today.

This new way of giving the death penalty was challenged in *Gregg v. Georgia* in 1976. In a 7-2 decision, the justices

upheld the statute under which Troy Gregg was sentenced to death. Since thirty-five states rewrote their death penalty laws after *Furman*, the Court clearly saw the states wanted to continue having capital punishment. The Court then looked at whether not the sentence was arbitrary and capricious. However, with the specific guidelines, two-step trial, and automatic appeal, it would have been difficult to argue this new sentencing method was arbitrary (Crew, 2001, p. 118). As mentioned above, the Court in *Furman* did not say the death penalty was illegal, so all the states needed to do was change the way in which it was administered.

How Much Does It Cost?

The idea of man deciding to take another man's life in the name of justice is not something to be taken lightly. As expected, there is much debate over the United States' use of capital punishment. Though it is a life-and-death situation, a factor in the debate is the cost of an execution. Overall, it is much cheaper to house an inmate in prison until he dies than it is for the state to execute him. This is because a trial for a capital crime is much more complex and time-consuming than other criminal trials at every stage of the legal process (Costanzo, 1997, pp. 62-63). Various experts are consulted, investigations and jury selections can take quite long to complete, and many court motions and appeals are filed. Having the two-part bifurcated trial means more time spent in court and allows more motions to be made by both the prosecution and defense. If one excludes the cost of the trial, as some proponents do, then capital punishment would be cheaper than a life sentence since there would be no inmate to house (Grant & Meyer, 2003, p. 412). When New Mexico abolished capital punishment in 2009, it cited the cost as one of the reasons (New, 2009). As states cut back on their budgets in these economic

times, perhaps more states will choose to end their capital punishment system.

In the California Commission for the Fair Assessment of Justice done in 2008, California's death penalty system was found to cost \$137 million per year. The Commission predicted that if California instituted lifetime incarceration, the cost would dramatically drop to \$11.5 million ("Death," 2011). The difference in cost between housing a general population prisoner and a death row inmate is around \$90,000, which works out to be \$63.3 million per year ("High," 2008). The American Civil Liberties Union found one death penalty trial came with a \$10.9 million price tag, and others have been in the multi-million dollar range ("High," 2008). San Quentin Prison's former warden wrote that the money saved by abolishing capital punishment could be used for programs designed to help the at-risk communities that many offenders come from (Woodford, 2008).

Data about the budget for executions have been gathered from many states. A study done in Kansas in 2003 estimated the median cost of a capital trial at about \$1.26 million. That is 70% more than the \$740,000 median cost of a comparable non-capital trial ("Death," 2011). A Tennessee report identified death penalty trials as costing 48% more than life imprisonment trials in 2004 ("Death," 2011). Research by the Urban Institute from Maryland in 2008 showed a more drastic cost of \$3 million per capital trial. ("Death," 2011). Florida put two men to death in 2009 with an average cost of \$24 million per execution (Mears, 2009).

OPPOSING VIEWS

The Legal Procedure

Proponents of capital punishment would like a more streamlined court system that would speed up the trials. They argue that

unnecessary and time-consuming delays lead to the higher costs (Mears, 2009). Also stated is that the death penalty can be used in plea-bargaining to avoid a costly trial. For example, a prosecutor would use the threat of a possible death sentence to persuade a defendant to plead guilty to a lesser crime and face life imprisonment instead. Opponents see the delays as safeguards that work to prevent violations of rights or wrongful convictions. Opponents see the high cost of capital trials and executions as a waste when the life-without-parole option is cheaper (Costanzo, 1997, p. 69).

No system is perfect, and the capital punishment system is no exception. It is criticized as being too slow, sometimes taking ten years between the imposition of a death sentence and the execution (Schmallegger, 2009, p. 408). Again, death penalty supporters would like some of the proverbial red tape to be cut away to expedite the execution process. In 1991 and 1995 respectively, the Supreme Court did away with repeated filings by an inmate for the sole purpose of delaying his execution and required more than just new evidence to rehear his case (Schmallegger, 2009, p. 408). Those two acts served to stop the common practice of filing an appeal solely for the reason that the inmate would put off his punishment.

Does the Death Penalty Deter?

Deterrence is one reason that capital punishment exists. The idea relates to the psychology theory of punishment, which states that an action leading to an undesired result will keep people from performing the action. From this, the thought is that such a severe punishment as death will discourage people from committing murder. Proponents of the death penalty often point to deterrence to build support for their beliefs, while opponents point to studies that seem to prove otherwise.

Research in 1975 seemed to indicate that every execution led to seven or eight fewer murders (Grant & Meyer, 2003, p. 412). The thought was that the murder rate dropped when criminals realized they could potentially have their life taken from them as punishment. In England, a similar study concluded that each execution prevented four murders (Travis, 2001). Also, prosecutors and judges have stated that in the testimony of people accused of crimes, the accused admitted to planning his crime in a way so he would not receive a death sentence. If one excludes the cost of the trial, as some proponents do, then capital punishment would be cheaper than a life sentence since there would be no inmate to house (Grant & Meyer, 2003, p. 412).

Opponents bring up just as much evidence that no sort of deterrence effect exists. Of all the Western countries, the United States is the only one to still use the death penalty yet has the highest homicide rate in the industrialized world. A study by the United Nations in 1998 found no proof that capital punishment lowered crime rates (Robinson, 2005). In 1996, states with capital punishment laws had an average murder rate of 7.1 per 100,000 people, while states that abolished capital punishment had an average murder rate of 3.6 per 100,000 (Travis, 2001). With both sides of this argument having seemingly valid claims, it is difficult to establish how large a factor deterrence is in this debate.

It seems quite reasonable that the deterrence effect would come into play. Why would someone commit a crime that would lead to his or her own demise? The potential rewards of the crime would have to far outweigh the risk of a death sentence. But the reality is if someone is going to commit a capital crime, the fates of others who have committed the same crime probably do not cross the person's mind. A man can kill somebody out of revenge, for

personal gain, or because he is afflicted with some sort of disorder, but society will seek revenge against him through capital punishment in an effort to set an example.

Religious Justification

Religion might be brought up as a justification for capital punishment, especially in Islamic countries where the religion is the motivation behind punishment. No Middle Eastern country has abolished capital punishment, and crimes forbidden by Allah carry a mandatory penalty of death (Travis, 2001). The Qur'an also mentions the death penalty, saying that a man taking another man's life is like taking the lives of all men; in other words, murder is a crime against everyone ("Does," 2008). Muslim countries enforcing Sharia, God's law, have the most crimes punishable by death. A few countries do not use the death penalty but still retain it in their laws ("Does," 2008). From a Christian view, the Bible references the death penalty many times and the distinction is made between murder and a legal taking of life. But different translations and interpretations can lead to disagreements among Christians over what a passage actually means. Because of the differences, opinions of capital punishment vary within the religion. For example, the Lutheran Church: Missouri Synod does not object to the death penalty while the United Methodist Church does ("Religion," 2010). Hinduism and Buddhism are religions that stress forgiveness and respecting fellow humans. Mohandus Gandhi, a well-respected figure in the Hindu community, said, "An eye for eye only ends up making the whole world blind" (Peace, 2009). Tenzin Gyatso, a Dalai Lama of the Buddhist faith, believes that all criminals have the possibility to improve and correct their behavior. He mentions the amount of violence and killing seen on television to show how misguided we have become regarding human values

(Gyatso, 1999). With such finality as death, how can the offender be allowed to be rehabilitated and make up for what he or she did? He appealed to the world to end capital punishment. The words of the two important people conform to a view against the death penalty.

CONTROVERSIES

DNA Evidence

Advances in science and technology have led to improved evidence-analyzing techniques for analyzing evidence. Hair or blood from a 15-year-old crime scene can be looked at again and might give a different outcome from the first time it was examined. At the time of the trial, DNA testing may not have been as common or reliable as it is now. For example, a single strand of hair could be destroyed in the DNA testing process but not produce a conclusive result. This would essentially be a waste of the evidence and it could not be retested. Today's demand for DNA tests has backlogged many labs. In 2005, The Texas Department of Public Safety crime lab handled between 2,500 and 3,000 DNA cases each year (Handwerk, 2005). This, combined with a lack of public funding for such tests, means the wait times for the results are much more than the hour it takes on popular television shows.

DNA analysis of evidence has certainly been used in capital trials and appeals. In 2000, Illinois governor George Ryan put a hold on executions in the state. Since the Supreme Court lifted the national moratorium in 1976, Illinois had executed twelve people and released thirteen, some of them based on DNA-related evidence (McCuen, 2000). Ryan was a death penalty supporter but believed those numbers meant something was wrong with the system. Even with the reformed trial process, the capital punishment system is still subject to human error. Bad lawyers, incorrect

eyewitness accounts, forced confessions, mishandled evidence can lead to and innocent person being convicted of a capital crime. A small piece of hair could have been the key piece of evidence in someone's murder conviction, but if a DNA test proves it belonged to someone else then the conviction would be based on false evidence. Though this does not mean the person was innocent, it does mean that a new trial may be needed to examine all other evidence other than the hair (Thornburgh, 2010). While the use of DNA testing does not conclusively find guilt or innocence, it has proved to be invaluable to those are now out of prison due to a test.

Media Influence

The media corporations are tasked with providing the public with an unbiased source for the happenings of the world. But the media system, like that of capital punishment, is not perfect. Certain parts of a story can be stressed or omitted in order to spin the news toward a specific audience or to make the story seem like something it isn't. It is well known that a person with a liberal political view most likely opposes capital punishment while a person with a conservative political view most likely supports it. Any news station or newspaper that leans to the liberal or conservative side will shape the story to fit the political views of their readers or viewers.

One example is Ronnie White, a black judge nominated for the federal system. In the confirmation stage, some objected to White since he had a strong anti-capital punishment record, which included voting to spare a convicted murderer. When his nomination was rejected, the media reported that it was due to racial issues instead of looking at his death penalty stance. (Irvine & Kincaid, 2000).

Another example comes from an Associated Press headline in 2005. An appeals court had just looked at case with a

man convicted of murdering a two-year-old and sentenced to death. The appeals court ruled that he was entitled to a new trial as a result of incompetent counsel in the first one. The AP's headline for the story was "Child Killer's Death Penalty Overturned." This seems to imply that a court took away a death sentence for a child killer even though they really just awarded a new trial because of legal error (Elliott, 2005).

Racial Bias

Many opponents of capital punishment oppose it because of the claim that the system is unfair to minorities. Ninety-eight percent of district attorneys in states with capital punishment laws were white in 1998, while only one percent was black ("Facts," 2011). Since 1976, there have been two hundred forty-nine black people executed for killing a white person, but fifteen white people executed for killing a black person ("Facts," 2011). Over a five-year period in the 1990s, the chance of receiving the death penalty was three and a half times greater when the victim in the crime was white (Boger and Unah, 2001). Even though the Supreme Court found the revised death penalty statutes constitutional in *Gregg*, opponents claim that statistics like those above indicate that a racial bias exists today.

METHOD

It goes without question that today's society would not tolerate some of the older methods of execution. Evolving standards of decency in regard to the Eighth Amendment would not allow an inmate to be impaled on a pole to die. Currently, the United States can execute people by lethal injection, electrocution, hanging, gas chamber, and firing squad (Schmallegger, 2009, p. 408). Most states will use death by a lethal combination of injected drugs since it is viewed as the most humane, but the inmate may be able to choose by which

method he dies. Lethal injection involves three drugs injected one after the other. The first drug puts the inmate to sleep, the second stops breathing, and the final one stops the heart (Descriptions, 2010). One of the concerns is that the first drug will not put the convict to sleep, leading to pain when the other drugs are injected.

Until recently, the first drug most commonly used was sodium thiopental. The only U.S. company that made the drug disapproved of its use in the lethal injection process and ceased production earlier this year. Instead of delaying their capital punishment, some states procured the drug but did not disclose where they obtained it. Multiple lawsuits were filed claiming the drugs might be counterfeit and unsafe (Drug, 2010). If the drugs were from a foreign country and not evaluated by the Food and Drug Administration, they could cause enough pain to be considered cruel and unusual punishment. Some states have simply switched to a similar drug instead of trying to legally obtain sodium thiopental. Pentobarbital is best known for euthanizing animals but is now being adopted as the first drug in the lethal injection process. Oklahoma, Ohio, and Texas have made the switch to pentobarbital, and the first two have carried out executions using the new drug (Grissom, 2011).

Overview

With a topic like capital punishment, the information available can be overwhelming. It has kept the same name yet changed its appearance over the thousands of years of its use. The public spectacle for all to see has now become a more private affair. Methods that seem deplorable by today's standards are long gone, replaced by a more civilized society with a more humane method. A long list of capital crimes has been whittled down to a handful. It was once supported by an

overwhelming majority and now has a fiery debate about it. Death penalty laws will surely continue to be shaped and modified as the United States criminal justice system moves forward.

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Fashioning the Self: The Symbolic Nature of Dress in Eighteenth-Century France

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On July 17, 1789, Louis XVI appeared before a crowd at the Hôtel de Ville in Paris with a tricolored cockade, *cocarde tricolore*, which had been given to him by the mayor of the city. This act received mixed reviews from the people of France; some appreciated the gesture, while others, including Marie-Antoinette who stated, "I did not think that I had married a commoner," were more disapproving. Regardless of the varying opinions, Louis' decision to associate himself, and therefore the monarchy, with the cockade cemented the small ornament as a national symbol of France.¹ The influence granted to this seemingly minor event is profound; while the cockade is composed of mere fabric, the meaning behind it is what gives it such potency. However, the tricolor cockade is just one example of the powerful effects of fashion during eighteenth-century France. Dress in France from 1770-1800 featured rapid changes in style which were symptomatic of greater shifts that were occurring in society. While fashion has been used for centuries to display markers of identity or ideology, it became a particularly powerful symbol of identification during years surrounding the French Revolution.

The ideas that fashion conveys meaning and is subject to certain historical influences have been well established by scholars. The symbolic nature of clothing can be divided into two larger categories, namely the symbolic function of dress in society and its role in defining individual identity.²

¹ Richard Wrigley, *The Politics of Appearances: Representations of Dress in Eighteenth Century France* (Oxford: Berg, 2002), 99.

² The following scholars discuss the impact of fashion within society: Madeleine Delpierre, *Dress in France in the Eighteenth Century*, trans. Caroline Beamish (New Haven: Yale University Press, 1997); Aileen

Furthermore, both of these categories are informed by the historical and cultural context of the period; therefore, throughout this research project, maintaining a clear grasp of the social and political narratives within eighteenth-century France has been of the utmost importance. For an understanding of French fashion and its changes throughout history, Aileen Ribeiro and Madeleine Delpierre are particularly useful. Both authors are influential to the research of this topic because they not only explain the changes in fashion during the eighteenth-century, but they also describe them. In addition to the importance of description, the authors also make contributions to the interpretation of eighteenth-century clothing within the context of the contemporary society and culture. For more specific periods of fashion, Richard Wrigley engages in important discussions of revolutionary era France. Wrigley's work has been critical to

Ribeiro, *The Art of Dress: Fashion in England and France 1750 to 1820* (New Haven: Yale University Press, 1995); Wrigley, *The Politics of Appearances*. Works that explore fashion and personal identity include: E. Claire Cage, "The Sartorial Self: Neoclassical Fashion and Gender Identity in France, 1797-1804," *Eighteenth-Century Studies* 42, no. 2 (2009): 193-215, doi: 10.1353/ecs.0.0039; Lynn Festa, "Personal Effects: Wigs and Possessive Individualism in the Long Eighteenth Century," *Eighteenth-Century Life* 29, no. 2 (2005): 47-90, doi:10.1215/00982601-29-2-47; Nina Rattner Gelbart, "The Blonding of Charlotte Corday," *Eighteenth-Century Studies* 38, no. 1 (2004): 201-21, doi:10.1353/ecs.2004.0058; Desmond Hosford, "The Queen's Hair: Marie-Antoinette, Politics, and DNA," *Eighteenth-Century Studies* 38, no. 1 (2004): 183-200, doi:10.1353/ecs.2004.0060; Caroline Weber, *Queen of Fashion: What Marie Antoinette Wore to the Revolution* (New York: H. Holt, 2006).

the furthering of my research for its in-depth and historically relevant analysis of dress during the French Revolution. This is of particular importance because contemporary economic, social, and political events are significant when investigating the meanings behind clothing in eighteenth-century France. Fashion is a canvas onto which the values of the culture are painted. Therefore, clothing has an important function within society as an indicator of public opinion and as a system of representation for important historical events.

In the vein of Ribeiro, Delpierre, and Wrigley, the style of analysis presented in this project is an extension of previous scholars' research. In the following pages, I aim to substantiate and corroborate the claims that fashion is symbolic and has a social meaning. While one of the primary purposes of this article is to illustrate the symbolic quality inherent in eighteenth-century French fashion, this project is also intended to demonstrate the significance of sartorial analysis to historical interpretation. Primary resources are of utmost importance to effective historical research, and current historical research is dominated by written documents. While written documents are often crucial to research projects, an analysis of clothing and images of clothing can offer equally interesting and enlightening results. Although clothing and fashion analysis may be more suitable for certain topics than others, it should still be recognized as a viable research subject, and students of history should be open to including it their historical investigations.

Unlike written documents, which often include detailed facts and information, the meaning of visual documents, such as paintings, is often more elusive. Therefore, it is important to state that this type of research is by nature interpretive and relies heavily on the analysis of images from France during the late-eighteenth century.

However, the field of semiotics serves as a guide and a fundamental approach to the study of the historical influences inherent in French fashion. For the purposes of this project, semiotics serves as a theoretical, rather than methodological, framework through which fashion can be examined. I chose to use semiotics because it gives credence to the study of the symbolic nature of eighteenth-century fashion. For this research, it will function primarily as a conceptual lens for historical interpretation and as a foundation on which sartorial analyses may be built. In its most basic definition, semiotics is the study of signs and symbols and the meanings they may communicate. Within semiotics, signs are composed of two parts: a signifier and a signified; the signifier is the image, word, or object and the signified is the concept to which it is attached. This basic approach can be used in a variety of disciplines to study many different aspects of culture, including advertisements, gestures, language, and, in the case of this project, fashion.³ For instance, in *Les Adieux*⁴ (Figure 1) the elaborate and heavily ornamented dress of the woman clearly represents her status, power, and wealth within society; while, in *Le chanteur Chénard en sans-culotte*⁵ (Figure 2) the wardrobe of the man, which consists of anti-aristocratic long pants, symbolizes the ideal citizen during the French Revolution.

With respect to clothing, semiotics can be used to uncover patterns in culture and systems of cultural change.⁶ Furthermore,

³ Arthur Asa Berger, *Signs in Contemporary Culture: An Introduction to Semiotics*, (New York: Longman, 1984).

⁴ Jean-Michel Moreau le Jeune, *Les Adieux*.

⁵ Louis Leopold Boilly, *Le chanteur Chénard en sans-culotte*, 1792.

⁶ Diana Crane, *Fashion and Its Social Agendas: Class, Gender, and Identity in Clothing*, (Chicago, University of Chicago Press, 2000).

the different aspects of fashion, including clothing, hairstyles, and jewelry, can interact in interesting ways to reveal additional cultural meanings. Using semiotics to study eighteenth-century French fashion not only helps to explain the meaning behind clothing choices, but it also serves as a method of attaining a greater understanding of the society and its culture. While semiotics can at times appear to be too broad, it is important to note that signs are always interpreted within the cultural narratives from which they originated. Therefore, historical events and philosophical and social ideas that were influential in France during the eighteenth-century will be taken into account during the course of this research project as an aid for the analysis of the period's fashion.

Clothing is one of the most powerful forms of symbolic display precisely because of its association with the body. With dress, there comes the idea that choosing which clothes to wear is a voluntary act and, therefore, signifies a deliberate meaning.⁷ Clothing provides an outlet where an individual's beliefs and values can be easily communicated and displayed in an illustrative manner; in this case, fashion can be thought of as a visual text. While it is true that many individuals do not consciously choose clothing that will communicate a specific message, fashion still articulates an idea whether the wearer intends it to or not. Through clothing, societal values are perpetuated and represented with or without the conscious acceptance of the individuals who wear them. Fashion is also particularly useful in transmitting meaning in cultures and societies where education is not prevalent in every class. This was certainly the case in

revolutionary France as not all of the citizens were literate; therefore, specific aspects of fashion made it easy for individuals to understand and place others within a certain social or political background.

As a result of the constant changes and shifts in style, analyzing dress allows one to interpret the effects of current events and new ideas as they occur and from a different perspective than what is given in other primary documents. For the purposes of this article, my research begins during the 1770s; I chose to start at this time rather than in the 1780s because it was during this decade that France witnessed the introduction of an individual who would have a profound impact on court fashion, namely Marie-Antoinette. The 1770s and early 1780s were characterized by elaborate and heavily decorated gowns, which culminated in the court dress *à la français* (the dress in *Les Adieux* is an example of this style). That this style of dressing was only followed by the aristocratic class is clear for at least two reasons; first, the dresses that were worn in Versailles were far too expensive for the majority of France, and second, they were extremely impractical. The dresses that the women of the court wore made it virtually impossible for them to bend over, the extensive panniers required women to enter doors sideways, and even the act of crossing one's legs was considered difficult.⁸

Getting dressed for the day took hours in the morning and required the assistance of at least one other person, which was a luxury most women could not afford; however, for wealthy women being elegant required them to "show that a great number of people have worked to produce the effect."⁹ The fact

⁷ Katrina Navickas, "That sash will hang you': Political Clothing and Adornment in England, 1780-1840," *Journal of British Studies* 49, no. 3 (2010): 541.

⁸ Ribeiro, 54.

⁹ Mary D. Sheriff, "The Portrait of the Queen," cited in *Marie-Antoinette: Writings on the Body of a Queen*, ed. Dena Goodman (New York: Taylor & Francis Books, 2003), 49.

that fashion in the 1770s was difficult for the majority of French women to follow was one of the style's main purposes. Dressing in the fashions of the 1770s and 1780s clearly demonstrated the status of the individual to the general public. Portraits and drawings that feature women in ornate gowns show not only their wealth but also their power within society. One of the aspects of court life that revolutionaries took issue with was the extravagance of their fashion; it revealed an aristocracy that was out of touch and separated from French society. The frivolity of this period of fashion aside, dress during this time was used to communicate other messages in addition to displaying the status of the wearer.

During the French Revolution, fashion was used to convey specific meanings to others that spoke of current events; however, the practice of utilizing clothing and accessories in response to recent political and social events was documented in France before the Revolution began often to very absurd effects. For instance in 1779, French victory in the Battle of Ouessant led to a hairstyle known as *à la Belle-Poule* in which a model of one of the ships involved, the *Belle-Poule*, was added on top of the already towering wigs of elite women (Figure 3). In the same year, the capture of the island Grenada by *compte d'Estaing* inspired the hat *à la Grenade* replete with pomegranates. Breakthroughs in society were also celebrated with new hat styles including *à la Montgolfier* in honor of the first balloon flight by the Montgolfier brothers in 1783 and the hat *à la Blanchard* or *au demi-ballon* for the invention of the parachute. Furthermore, Beaumarchais' *Mariage de Figaro* and *Tarare* inspired many different styles of jackets and hats.¹⁰ The fact that clothing, accessories, and hairstyles were created in reference to current events shows

¹⁰ Delpierre, 117-118.

that fashion was not exclusively considered in sartorial terms; men and women understood that clothing could be used to engage in a public dialogue about political and social occurrences.

Just from this short list of hair and hat styles one can begin to understand the importance of these aspects of fashion to the French in the 1770s and early 1780s. While existing simultaneously in the private and public sphere, as a result of its connection to and extension from the body, hair takes on strong cultural and symbolic meaning. Because of this dual state, hair "has so often been thought of as containing the essence of individuality and personhood."¹¹ Perhaps owing to its inherent malleability, hair can easily be used to assert a sense of identity; easier to change than clothing and just as noticeable, hairstyles can be used by women to construct their individuality or image. Hairstyles are often symbolic in nature; they can be used to assert power or control, rebel against society, or portray ideologies. In accordance with fashion, hair during this period was covered by wigs and heavily powdered; during the Revolution powdered hair became a distinct symbol of aristocracy, and those who dressed their hair in such a way were often deemed counter-revolutionaries. Conversely, early in the Revolution, an individual with unpowdered hair was considered to be a revolutionary regardless if they were or not. For instance, in 1791, Monsieur de La Fayette noted an "individual wearing his own unpowdered hair (filthy hallmark of a reviled sect)." That a hairstyle was judged to be enough information to label a man as belonging to a revolutionary sect, likely the Jacobins, speaks to the significances afforded to hair and the messages it could convey.¹²

¹¹ Angela Rosenthal, "Raising Hair," *Eighteenth-Century Studies* 38, no. 1 (Fall 2004): 2.

¹² Wrigley, 233.

In the years just before the Revolution, fashion in France began to shift from intricate and elaborately designed gowns to simpler dresses and lower hairstyles. One of the more popular of these new styles was the dress *en chemise* which consisted of a sheer, muslin dress that was worn without the wide panniers that had characterized previous years of fashion (Figure 4). Philosopher Jean-Jacques Rousseau was often associated with the trend toward simplicity in dress that occurred on the eve of the Revolution. Rousseau's attitudes regarding clothing stemmed from his idea of the conflict between the "external vestimentary presentation and inner moral self." For Rousseau, the practical nature of clothing had been overshadowed by trivial fashions that seemed to be growing increasingly frivolous. Therefore, clothing was erroneously being used as a disguise or as a way for individuals to conceal their true character from others. Instead of the heavily stylized fashions that flourished during the 1770s, Rousseau recommended individuals to adopt simple clothing that facilitated "the body's capacity to express truly natural feelings."¹³

Rousseau's philosophy of dress influenced fashion during the late 1780s and into the Revolution; his suggestions for simplicity in fashion inspired participants of the Revolution to develop these ideas. For example, committees considered the notion of implementing a national uniform. As one such committee, the Société Populaire et Républicaine des Arts published the book *Considérations sur la nécessité de changer le costume français*, which provided suggestions on ways French fashion may be improved. Société Populaire et Républicaine des Arts recommended that clothing be hygienic and safe for the wearer because many people considered constricting boned corsets to be harmful to women, if not a type

¹³ Ibid., 230.

of torture device. Clothing should be loose enough to allow for freedom of movement and the birth of healthy children. It should comply with the ideology of equality and, therefore, be the same for all individuals regardless of wealth or status. Lastly, clothing should show the shape of the body and refrain from concealing its beauty. While many of these recommendations were reflected in subsequent fashions, the French never executed a plan for a national uniform except for their military.¹⁴

Although clothing during the French Revolution was simple compared to previous years, it carried with it a great deal of symbolism and meaning. One of the most important aspects of revolutionary fashion was the cockade. Cockades were most commonly made from fabric or ribbon and came in a variety of different colors and combinations. Cockades had been used as decoration on clothing and hats throughout the eighteenth-century and were not a novel invention, but with the advent of the Revolution they took on a greater importance. The most significant style of cockade during the French Revolution was the tricolored (Figure 5), which became a national symbol of France as I mentioned in the opening of this article. The national, tricolored cockade was composed of white, blue, and red; white had represented aristocracy or monarchy for many years, while the red and blue were the colors of Paris. Together, they symbolized France united under the new Republican ideals of liberty, equality, and fraternity. Although it was considered a national symbol, the tricolor cockade was not universally worn; revolutionary fashion would not prove to be so simple.

Perhaps the most common controversy concerning cockades involves color. Wearing an all-white cockade during the Revolution represented support of the

¹⁴ Delpierre, 122.

monarchy; such individuals were often criticized as being counterrevolutionaries or royalists. The friction that existed over the issue of cockades is evidenced by the laws that were created to regulate their usage. As early as 1790, Louis XVI issued a proclamation that forbade individuals from wearing all cockades other than the national tricolor cockade; later in 1792, it was made mandatory that all citizens wear the tricolor cockade. With more and more people wearing cockades, confusion erupted over the problem of where an individual should place their cockade. Partially covering a cockade with one's scarf or a ribbon led to suspicion; police reported that "people want to place it on the right, on the left, on the front, behind, and this frivolous question, which is not yet decided on, has already caused violent brawls."¹⁵ Eventually, the National Guard requested that people wear their cockade in such a way that everyone could clearly see one another's. While this type of paranoia is characteristic of the French Revolution, the fact that such a degree of hysteria surrounded this sartorial decoration is testament to its use as a powerful symbol of ideology.

The liberty cap (Figure 6), or *bonnet rouge*, was another article of clothing that was symbolically important during the French Revolution primarily due to its association with the radical group the *sans-culottes*. The red liberty cap was often linked to the Phrygian cap of Roman and Greek origins, a factor that may have been appealing the French revolutionaries who admired the Republican ideals of these past societies. Not surprising given its name, the red cap of liberty used during the Revolution was designed to represent liberty, equality, and solidarity among the French people. It is most often connected to the image of the *sans-culottes*, which translates as 'without breeches,' whose uniform consisted of the

bonnet rouge, a short jacket, and long pants.¹⁶ The wearing of long trousers is what initially garnered the group their name because they refused to wear the breeches worn by aristocrats and instead favored the commoner's pants. One of the most interesting aspects of *sans-culottes* history is the way their name came about. The name was originally intended to insult the group who donned peasant clothing; however, instead of attacking their social position or ideology, detractors chose to mock their choice in clothing. Out of all the ways the radical *sans-culottes* could have been scorned by their opposition, an article of clothing was one of the most noticeable and, therefore, powerful methods of categorizing them as revolutionaries.

The notion of 'fashion' indicates a move away from clothing as a necessity to clothing as a presentation of identity. In eighteenth-century France, fashion operated within a symbolic public sphere. Changes in styles and attitudes toward dress were symptomatic of broader shifts in society; this is particularly true during an age in France when clothing often represented a philosophical divide. In this case, clothing was an effective way to impart a personal self-representation to the public. It showed a sense of identity and self-fashioning that spoke not only of societal ideals but also of individual desires. Due to its significance during this period of time, fashion should be regarded as an important method of historical analysis for revolutionary France.

¹⁵ Wrigley, 108.

¹⁶ *Ibid.*, 215.



Figure 1. Jean-Michel Moreau le Jeune, *Les Adieux*.



Figure 2. Louis Leopold Boilly, *Le chanteur Chénard en sans-culotte*, 1792.



Figure 3. à la Belle-Poule hairstyle



Figure 4. Élisabeth Vigée Le Brun, *Marie-Antoinette en chemise*, 1783.



Figure 5. Shoes decorated with tricolor cockades



Figure 6. Red cap of liberty

Evaluation of Insect Treatments on the Effectiveness of a Schoenly Demographic Bait Trap

Richard Gilbert

Popular television series such as *CSI* and *Bones* have brought the practice of forensic entomology into the public consciousness. Forensic entomology is the use of insect evidence to aid in criminal investigations. By examining the variety of species and the development stages of insects present on a human body, information on the corpse's location and time spent outdoors can be determined. In some regards, the accuracy with which a forensic entomologist may determine the time a corpse has spent exposed to insects matches that of the forensic wizardry on display in popular depictions. In particular, fly larvae, more commonly called maggots, undergo several life stages, known as *instars*, which occur after a specific number of *heat-hours*. A forensic entomologist can quickly determine the age of a maggot from just a few key pieces of information: average temperature, species of fly, and instar stage. The age of a maggot found on a body is a minimum time of death. Forensic entomology, therefore, is a powerful tool for law enforcement.

Unfortunately, while entomological information such as instar developmental timetables are quite accurate, there are often additional variables that can make the job of the forensic entomologist more complex. Consulting instar development can at best determine a minimum time of exposure as the individual may have died before insects had access to the body. Even with access to human remains, insects do not colonize immediately. The smell of the putrefying flesh must have time enough to diffuse into the environment and reach the insects. The insects must then travel to the body, often no easy task for a creature only millimeters long. Additionally, there is the complex issue of insect succession. *Succession* in

biology refers to the several stages of a developing ecosystem. For example, consider a forest after a devastating fire. Some plant species will recover quickly and attract the first wave of animals to recolonize the forest. Over time, larger plants will grow and provide the structure needed for more animal species. Finally the forest will return to a mature state and feature its full complement of animal and plant species. Each of these steps is a *successional stage*. A body, from an entomological standpoint, represents such a huge new source of nutrients and a variety of habitats for insects that it is an ecosystem unto itself and undergoes successional stages. Rapidly moving flies colonize first, followed by slower moving beetles and other terrestrial insects. As larvae begin to hatch, they attract predators. When the larvae mature, they emerge from the body as a new generation of adult insects, representing a further stage of succession. Tying together all of the above information into a form useable by law enforcement is a daunting task, but methods have been developed to do just that.

When a law enforcement officer or forensic entomologist is faced with the task of indentifying the age of a corpse using entomological data, one of several authoritative manuals on the subject is consulted. These manuals contain information on the makeup of the insect community on bodies based on time of exposure. For example, the manual might explain that maggots of a particular genus appear around 24 hours after exposure, or that a certain predator beetle will be found in high number after 72 hours. These manuals summarize the entomological data rather than forcing the investigator to consider a

multitude of variables. The data in these manuals are not determined by simply theory or conjecture; rather, studies are undertaken in which cadavers are exposed to insect colonization, and the insect community at each time interval is examined, described, and recorded.

Certain basic principles guide the experiments that form the bulk of data in forensic entomology guides. Foremost, there is a tradeoff between maximizing the comprehensiveness of the study and minimizing the disturbance to the study site. Researchers attempt to maximize the comprehensiveness of the study by capturing a large number of insects. The goal is to determine exactly when a species becomes present on a body and how that insect population changes over time. Researchers are more confident they have collected a representative sample as the number of insects collected increases. However, a body left at a crime scene is different than one found in a field study as a body left alone will not have any insects removed from it during its successional development. The removal of insects from a cadaver being studied is a form of *disturbance*, sometimes referred to as the *observer effect*. The method of data collection, in this case collecting insects interacts with the subject rather than passively observing it and actually alters the subject's state. Only by not collecting any insects at all could disturbance be completely avoided. Researchers, therefore, must choose a methodology that achieves some balance between these two extremes.

The traditional method of the forensic entomology researcher involves a caged cadaver and hand or net collecting. The cadaver is placed into the field, and a barrier is erected to keep out large, non-insect scavengers, such as rats or coyotes. At regular timed intervals, researchers collect insects off the body using a variety of tools.

Sweep nets are used to capture flying insects, while terrestrial insects or insects on the body are captured using forceps, aspirators (a device that uses the researcher's intake of breath to create a vacuum and draw insects into a sample container), or even by hand.

An alternative to the traditional cage method is the Schoenly trap. A Schoenly trap allows for greater numbers of insects to be collected than the traditional cage method.

BACKGROUND

The Schoenly trap first appeared in publication in Schoenly, 1981. The Schoenly trap was designed to capture both outgoing and incoming insects to and from a baited location. This novel trapping method was able to capture both of these insect groups.

Since its initial publication, the Schoenly trap has been used by many other forensic entomologists. In Portugal, for example, a series of experiments by Prado e Castro (2010, 2011) used the Schoenly trap to greatly increase the knowledge of forensically-important insects for Portuguese researchers and law enforcement.

An analysis of the usefulness of the Schoenly trap in collecting insects was undertaken by Ordóñez, 2008. Ordóñez compared the Schoenly trap to traditional cage methods. Traditional cage methods involve the placement of insect bait, usually a pig carcass, inside of a wire cage to prevent disturbance of the carcass by non-insect scavengers. Insects are collected from the carcass either by hand or with a net. Ordóñez concluded that the Schoenly trap was more effective than these traditional methods for forensic entomology studies.

PURPOSE

While the effectiveness of the Schoenly trap versus traditional cage methods has

been established by prior research, there are still possible improvements to be made. Schoenly traps feature underground collecting devices to capture incoming insects (these devices are referred to as baffles in this paper). However, no attempt has been made so far to analyze how the presence of these baffles affects the results of an entomological study using a Schoenly trap. Therefore, this experiment will examine the differences between Schoenly traps with no baffles, two baffles, or four baffles. From the information gathered during this study, the most effective form of the Schoenly trap can be determined.

PREPARATION

An unused plot on the west side of the CSUS campus was selected to be the study site, and a 90 by 120 m area was cordoned off (Picture 1). Twelve points inside the study site in a three by four grid were selected to be the location of the traps and cages. The trap and cage locations were chosen to maximize distance between each trap to prevent contamination. This contamination would be insects feeding at one trap, then escaping and feeding at another trap. A backhoe was used to break up the soil at each location to house a trap or cage.

The Schoenly traps were constructed according to the specifications of Prado e Castro, 2009 (Picture 2). Several features should be noted (Picture 3). On top of each trap was installed a u-bend pipe leading to a collection jar. This top pipe also featured a small hole to allow a rope to reach into the central chamber and attached to the carcass cradle. This rope would allow researchers to weigh the carcass without opening the trap.

Of the twelve sides of each trap, four allowed access by insects into the central chamber with the carcass. Four of the sides featured exits that lead into collecting jars. Of the remaining four sides, either zero, two, or four featured interior immigrant

collection jars. These interior collection jars were accessible to researchers via PVC pipe “baffles” that extended from under the trap to ground level (the bottom plane of the trap). These baffles are the novel addition to the standard construction that this experiment was designed to study.

Both the top and bottom of the structure allowed some exchange between the interior of the trap and the outside environment. The top “pyramidal” portion of the trap was made of a permeable screen, which allowed sunlight and air into the trap while preventing the loss of insects. The bottom of the trap featured a wire screen that allowed a soil-carcass interface to form. In a natural environment, the carcass would likely have contact with the ground, so soil contact is allowed to take place to ensure a decomposition process that is as natural as possible.

The cages for the traditional treatment were also constructed by the researchers (Picture 4). (In scientific research, a treatment is an independent variable that is manipulated by the researcher. The cages, and each version of the Schoenly trap, with zero, two and four baffles, are treatments in this study.) A chicken wire mesh was used to form five sides of a rectangular cube. Rebar poles were used to stabilize the cage, and the mesh fastened down with stakes and rubber straps.

A weighing tripod was constructed to allow measurement of the mass of the pig carcasses (Picture 5). The tripod could be used to attach an electronic scale. A rope would be attached to the carcass cradle and lifted to the electronic scale to allow weighing.

Four temperature and moisture data collectors were also installed at the study site (Picture 6). One data collector was placed out in the open in the center of the study site to allow monitoring of the ambient environment. One additional data

collector was placed in a trap of each of the three treatments (no baffles, two baffles, and four baffles). These will allow the researchers to examine the effect of the baffle treatments on the environment inside the Schoenly trap.

After construction and installation of the traps and cages, the study site was left alone for one week to settle. At this time, the collection jars were not filled with collecting fluid. This period of time ensures that the normal insect population returns to the study site after being disturbed by the installation process.

After the traps and cages were allowed to settle, the collection jars were “armed.” A mixture of water, ethylene glycol, and detergent was placed into each collection jar. This liquid, Morrill’s solution (Morrill 1975), is used to kill the insects that fall into the collecting jars.

The armed traps were allowed to collect insects for one week without pig carcasses. The insects collected during this time form the background fauna. The background fauna are the insects that wandered into the trap accidentally and were not attracted by the pig carcass. By establishing what species of insects make up the background fauna, these species can be ignored when determining which species were attracted to the pig carcass during the study.

After collecting background fauna, twelve pig carcasses were obtained and installed into the traps and cages (Picture 7). The pigs were obtained from a local vender and treated in accordance with the CSU Stanislaus animal welfare regulations (CSU Stanislaus Policy, 2011). Each pig had a starting weight of 10-13 kg. The carcasses were placed into wire “carcass cradles.” These cradles allowed the pigs to be lifted up and weighed during the study. Finally, the pigs were placed inside each trap or cage. In the case of traps, the top portion

was securely attached and not opened again until the conclusion of the study.

METHODOLOGY

Each day of the study, the pig carcasses in each cage and trap were weighed. A cage would be opened and the weighing tripod placed over the carcass. The rope attached to the cradle under the carcass would be lifted and attached to the scale and a weight recorded. In the case of pig bodies in traps, the rope would be lifted through the top hole to avoid opening the traps and allowing insects to escape.

Collection vessels would be prepared each day for each trap and cage. Each vessel would be labeled with the day of the study, the unique trap or cage identification, whether the insects were immigrating or emigrating in the case of traps, or whether the insects were collected by hand or by sweep net in the case of cages.

Insect specimens from Schoenly traps were gathered from two types of sites: the five outgoing emigrant traps found on each trap, and the two or four underground immigrant traps found under treatments with baffles (Picture 8). Emigrant and immigrant insects would be collected from these sites and placed into separate collection vessels.

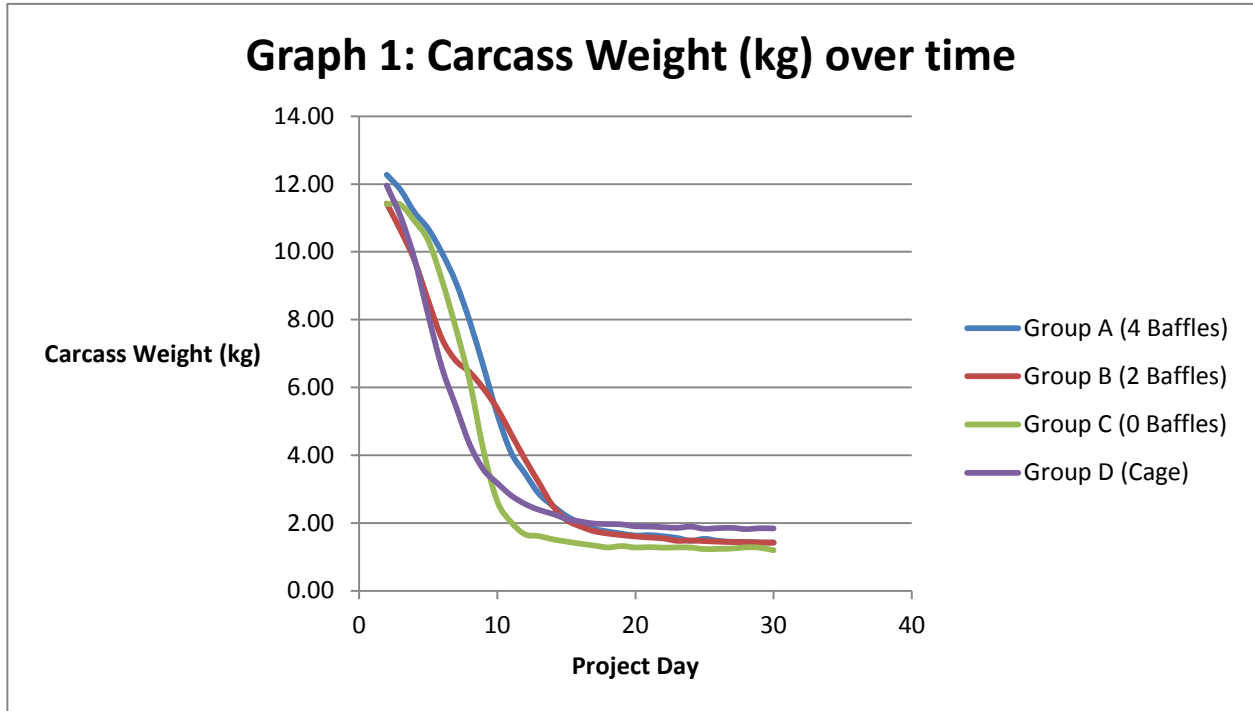
Insect specimens from traditional cages were collected both by hand and by sweep netting (Picture 9). In either case, one researcher would undertake collection for one minute, attempting to capture as many individuals as possible. A one-minute interval without collection would then occur, to allow disturbed insects to return to the carcass. A second minute of collection would then be undertaken, and this process continued until five minutes of both sweep netting and hand collection had occurred.

Preliminary Data and Analysis

The weight of the pig carcass in each trap was measured daily. The average carcass

mass for each treatment is summarized below in Graph 1. From this preliminary data, several observations are possible. The graph of average carcass mass for each treatment can roughly be divided into two major stages: a stage of exponential loss of mass, from day 2 to about day 15, to a static

area of almost no change in mass, from about day 15 to day 30. There are differences between the three treatments of Schoenly traps. However, more statistical analysis is necessary to determine if the variation in mass loss is significant or within normal random variance.



The loss of mass for the cages was initially more rapid than the loss of mass for the Schoenly traps; however, the final total weight for the traps was ultimately lower than the weight of the caged carcasses. A hypothesis can be ventured for these results. The caged carcasses were more exposed to the elements, while the carcasses in traps were more insulated. The rapid initial weight loss seen in the caged pigs could be due to an initial loss of moisture from the carcass, while the trapped pigs retained more of that moisture longer. This is only speculative, however; further analysis is required to determine a cause conclusively.

Some of that further analysis will include the examination of the temperature and moisture data collectors placed outside the traps and within one of each trap

treatment. The information collected from these data collectors will reveal if the traps did in fact retain more moisture than the exposed carcasses in the cages. In addition, differences in temperature and moisture can be compared between the three treatments of traps. It remains to be determined if statistically meaningful differences in temperature and moisture will be found in the different trap treatments. If such differences are found, it will be possible to examine them for correlation with weight loss rates.

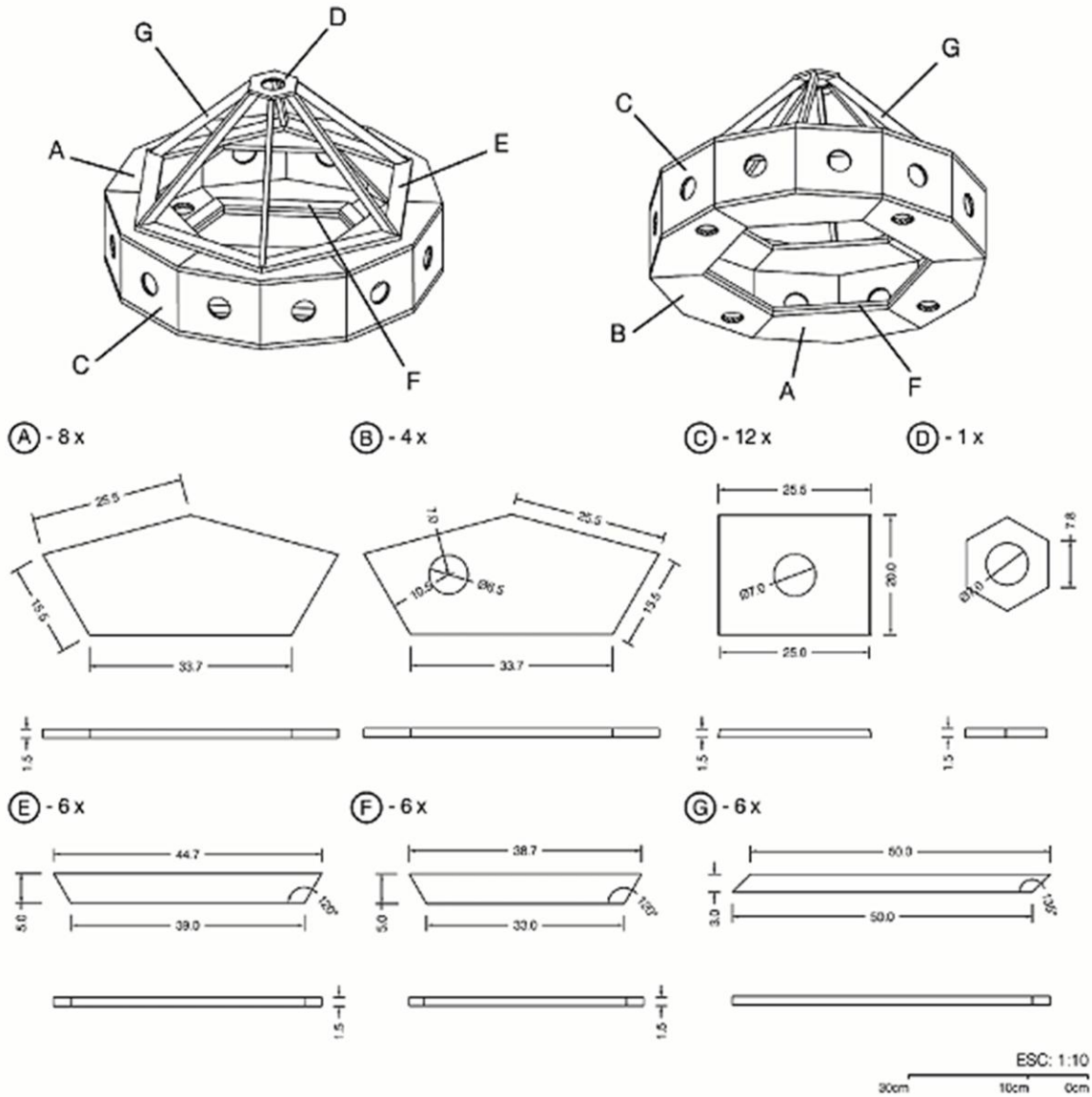
The last variable to be examined is the diversity of insects collected by the traps. Insect diversity is a measure of the number of difference species found. Each collection vessel will be examined and the insects collected will be identified. Results from the

traps are expected to include much higher insect diversity than traditional collecting methods based on prior literature. However, it is unknown whether different trap treatments will have an effect on insect diversity collected. In addition, insect succession may have been affected by different trap treatments, with certain insect species appearing sooner or later in the time table depending on the treatment used on the trap. It is the subject of insect diversity in the collected samples where the most work remains in analyzing and interpreting the data from this project.



Picture 1. The Study Site

MARINE PLYWOOD STRUCTURE



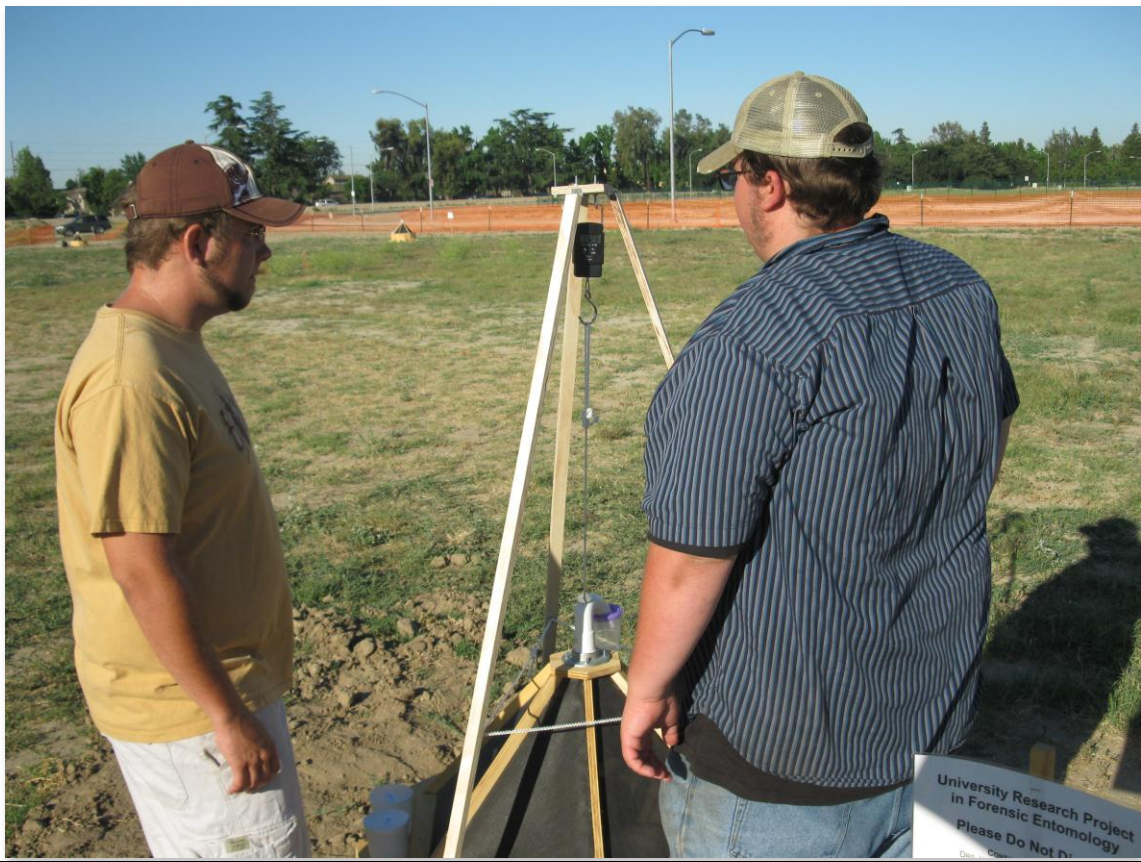
Picture 2. The Schoenly Trap.



Picture 3. Completed Trap.



Picture 4. Traditional Cage.



Picture 5. Weighing Tripod.



Picture 6. Interior Temperature/Moisture Data Collector.



Picture 7. Pig Carcass Inside Schoenley Trap.



Picture 8. Collecting Jars from Baffles.



Picture 9. Sweep Netting.

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Huntington's Disease 10 Years Later

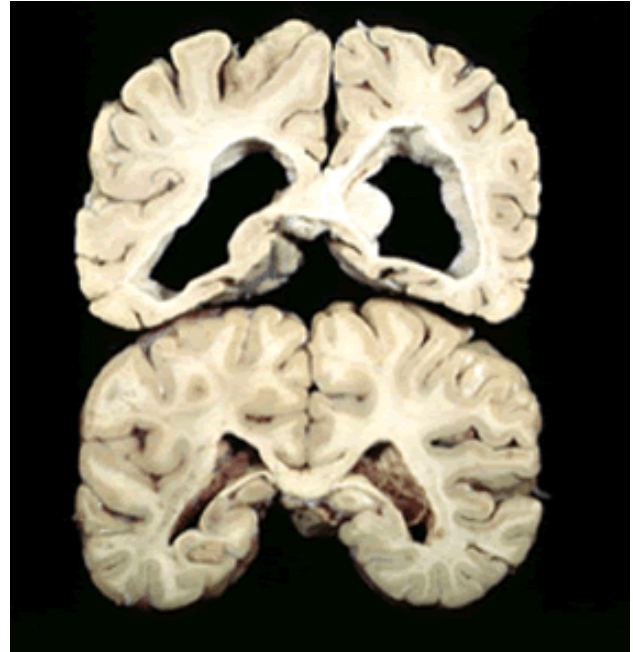
Meaghan Kingsley-Teem

Uncontrollable movements, memory problems, depression, decrease in mental acuity, and behavioral disturbances are just some of the symptoms associated with Huntington's disease. Huntington's disease is a progressive neurodegenerative disorder which is caused by a defect in the gene that codes for the protein huntingtin. Tests are now available to detect the trait before symptoms develop, but complex social issues still surround testing. Questions still remain about who should be tested (Riordan and Loescher 2006), why and when they should be tested (Decruyenaere et al.1995), and how to handle the results (Mennie, Holloway, and Brock 1990). To gain insight into these questions, I will be analyzing trends in interviews with individuals who decided to undergo direct testing for Huntington's disease 10 years ago.

BACKGROUND

Huntington's disease is caused by a defect in the huntingtin protein. The defective huntingtin protein induces apoptosis, or programmed cell death, of brain cells called neurons in multiple parts of the brain affecting speech, memory, motor activity, and even personality (Bano, Zanetti, Mende, & Nicotera 2011).

The damage caused by the abnormal protein starts early in life, but symptoms may not appear until the fifth decade of life. The most common age of onset for the disease is age thirty-seven, but the incipient manifestation of the disorder varies widely based on the severity of the mutation and environmental factors (Hockly et al. 2002, Wexler 2004).



The human brain, showing the impact of HD on brain structure in the basal ganglia region of a person with HD (top) and a normal brain (bottom).

<http://kobiljak.msu.edu>

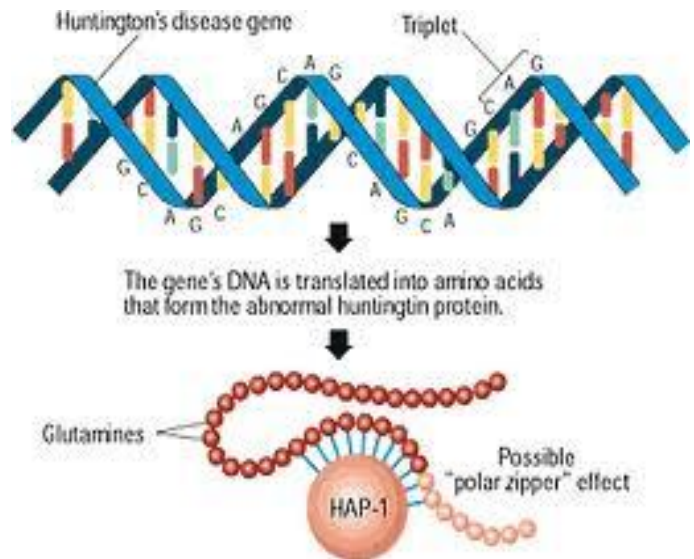
The disease is largely hereditary, but in some rare cases can occur randomly. For this study we will focus on the hereditary form which passed through families in an autosomal dominant pattern. This means that if a person's mother or father had the condition, that person stands a 50% chance of developing the condition.

The coupling of the late onset and strong hereditary pattern left families who knew they carried the trait with a great deal of uncertainty. Because the disease normally shows no symptoms until after many people have their children, individuals who knew they were at risk for the disease would have to decide whether to have children and risk

passing the disease on to them or forego childbearing. Additionally, many people would choose not to marry believing that they carried the disease. Career and educational choices also had to be made based on a person's best guess as to whether or not they had the condition. Many people would live in fear of the disease only to never develop symptoms. Others would build their lives as if they were not at risk only to begin having symptoms. This was the reality of life for those at risk for Huntington's disease until linkage analysis was invented in 1983 (Meiser & Dunn 2000).

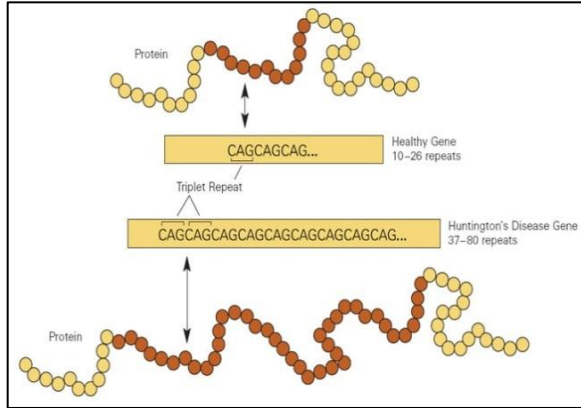
Linkage analysis is by no means a perfect test, but it did give persons at risk for Huntington's disease a better idea of whether or not they would develop the condition. By linkage analysis, a person who had previously only known she had a 50/50 chance of inheriting the gene responsible for Huntington's disease would be able to learn if she would develop the condition with as much as 98% certainty. This was a huge breakthrough, and for many people it alleviated the torture of trying to plan their lives in the face of uncertainty. Although the test was not 100% certain, they could at least make their decisions in a better informed manner.

In 1993 the uncertainty was completely eliminated when the gene mutation that causes Huntington's disease was isolated. The protein huntingtin had been mapped to the short arm of the fourth chromosome, which meant it could be tested for with 100% certainty by DNA sequencing. Additionally, the severity of the mutation could be analyzed and an approximate age of onset calculated based on the individual's number of "CAG" repeats.



From: <http://www.javeriana.edu>.

In humans, and all species that use DNA as their genetic code, there are four nucleotides that are arranged in a specific order to form out DNA. These nucleotides are Adenine (A), Guanine (G), Cytosine (C), and Thymine (T). Together they form long and complex codes, called genes, which are translated into the infinite number of proteins required by the body to function. One such protein is huntingtin, which is necessary in the human brain and elsewhere. In Huntington's disease patients, there is a defect in this gene. The gene has an elevated number of "CAG" repeats. Within the human genome there are areas where the number of time a given DNA sequence is repeated has little or no effect, but in others it can cause a disease state. This is the case in Huntington's disease.



A normal person, one who will not develop Huntington's disease, would have fewer than 27 CAG repeats at the 4p16.3 locus. An "intermediate" person would have 27-35 repeats (Meiser & Dunn 2000, Bhattacharyya 2008). Anything above 35 repeats is considered diagnostic for Huntington's disease. The most severely affected people have over 50 repeats and can have an onset of symptoms before the age of 20. This is called Juvenile Huntington's disease and is much rarer than the common form, which has an onset between the ages of 30 and 50.

By sequencing a person's DNA, the number of CAG repeats a person has can be counted and analyzed for Huntington disease trait. Persons who have more than 35 repeats will know without doubt that they will develop the disease. Individuals who have less than 27 repeats can rest assured that they will be asymptomatic. A person with an intermediate amount of repeats will have a higher tendency to develop dementia but will not develop full symptoms of the disease (Bhattacharyya 2008).

METHODS

Taking interviews of patients who elected to undergo testing for Huntington's disease 10 years ago, which were conducted by Rachel Koff, a graduate student in the California State University Stanislaus Masters in Genetic Counseling Program, and

a few of her colleagues, I will search for trends in the attitudes of the interviewees. Rachel and I will be searching for trends in the data using "coding." "Coding" is defined as the process of identifying similar trends in interviews and filing them under general phrases. The frequency of these phrases are then taken and compared to others in a statistical manner. This is done in order to achieve a clearer understanding of the interviewees' attitudes by eliminating researcher bias. Our goal is to find whether it has proven to be a positive or negative experience for those who have chosen to undergo genetic testing for Huntington's disease and how the test result has changed their lives.

SIGNIFICANCE

A definitive answer as to whether and individual will develop Huntington's disease might seem solely beneficial for the families affected by Huntington's disease, but psychological concerns must also be taken into account. For at risk individuals, being unsure if they will develop a neurodegenerative condition can cause a great deal of stress. However, a new set of stressors may come with a diagnosis or, for that matter, a lack of one.

Of patients who are diagnosed with Huntington's disease, 11%-33% report considering suicide as an option for their future rather than waiting for the disease to set in (Lawson et al. 1996). In fact, the second leading cause of death amongst Huntington disease patients is suicide (Roos 2010). However, the diagnosis alone may not be to blame.

There is shown to be a higher correlation of previous psychological adjustment than test result in determining depression in patients after testing (Lawson et al. 1996). This means that depression after testing is more strongly linked to depressive behavior prior to the test than the test result. It was also found that patients who undergo

direct testing rather than linkage analysis, regardless of result, are more likely to become depressed (Codori, et al. 1997). This might be explained by the dueling consequences of “survivor’s remorse” if negative and a sense of being trapped by the disease if positive.

Not surprisingly, it also found that patients who had a previous history of depression were more likely to have a major psychological crisis (suicide attempts, new drug abused, loss of regard for responsibilities or major relationships, etc.) after testing. Patients who had a positive result were more likely to have a psychological crisis in the months following receiving their results; however, over the long run there was no significant difference in the mental health of those who tested positive and those who tested negative (Duisterhof et al. 2001). However, in a five year study patients who tested positive for Huntington’s disease tended to have fewer positive thoughts than those who were cleared. They also were less willing to speak about Huntington’s disease and practiced more avoidance behaviors when questioned than those who tested negative. They also were shown to be considerably more “hopeless” using the Beck Hopelessness scale. Higher levels of hopelessness were correlated with marriage and lower levels with parenthood. The mechanism behind these trends is not understood. (Codori 1997).

Many studies have been conducted on the psychological events after Huntington’s disease testing, but very few have asked patients about their experiences. Speaking

directly to patients about their experiences might give researchers a better understanding of why these trends are seen and perhaps help find solutions.

PROJECTED FINDINGS

Coding data is only in its initial stages, but it appears that the majority of people are viewing their decision to be tested for Huntington’s disease as a positive choice. Very little data exist on patients’ attitudes toward testing after having been tested, but it is found that patients tend to have an interest in predictive testing (Kreuz 1996).

For patients who tested positive in our study, most interviews had to be obtained from caregivers rather than the patient due to the disease’s progression. This may pose a serious limitation because, as revealed in surveys taken before predictive testing was made available, the partners of people at risk for Huntington’s disease tend to have more positive feelings toward predictive testing than the patients themselves (Evers-kiebooms, Cassiman, and Van Den Berghe 1987). Most caregivers of patients who tested positive for the disease said that testing was a positive experience despite the result because it helped them to prepare for the future.

Of individuals who tested negative for the trait, many sight a sense of relief at finding negative results, but a few also acknowledged a sense of guilt when other members of their family proved to be positive. These are only preliminary trends. New trends may surface as the remainder of the data is analyzed.

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Sustainability and the San Joaquin Valley

Bryan King

Precipitated by a boom in population (200,000 to 3 million during the 20th century) and subsequent development over the last century, the San Joaquin Valley has become one of the most economically and socially challenged regions, not only in California, but in the country, as well (Teitz, Dietzel, & Fullton, 2005). With the population of the valley expected to double to about seven million people over the next 40 years, these pressing economic, environmental, social justice, and social relationship issues must be addressed if we are to restore well-being and economic vitality to the San Joaquin Valley (Teitz, Dietzel, & Fullton, 2005). Using “sustainability” as an all-encompassing notion, this article looks to transferrable examples from across the nation to see exactly how and where the San Joaquin Valley went wrong, and why certain communities are affected more than others. By identifying factors that have contributed to the present challenges facing the San Joaquin Valley, those living here may be able to develop strategies for restoring vitality to the region.

SUSTAINABILITY

A sustainable community, as detailed in this article, is one that meets the “needs and aspirations” of current residents without compromising the ability to meet those of future residents (Speth & Haas, 2006, p. 5). In this context, sustainability is comprised of three key components: economic, environmental, and social sustainability. In general, a sustainable community is one that offers quality jobs, renewable energy sources, affordable and adequate housing, parks, healthy food options, transportation, education, and adequate health care. As there exists no

standard or set level to which these criteria must be met in order for a community to be deemed “sustainable,” sustainability is better based on “to what degree” a community meets each criteria. Sustainable policies will be key in confronting the challenges currently faced by those in the San Joaquin Valley.

BACKGROUND

Even as one of the most challenged regions in the nation, the San Joaquin Valley remains one of the world’s most productive agricultural regions, and one of the fastest growing areas in the United States. Yet, despite containing some of the most productive farmland in the United States, average annual wages in agriculture and its related industries are a mere \$22,000 a year in the San Joaquin Valley. The San Joaquin Valley is tied with the far northern regions of California for the lowest median personal earnings, “roughly 24 percent (about \$7,000) lower than the state median” (Burd-Sharps & Lewis, 2011, p. 106). In 2001, per capita incomes in the South San Joaquin Valley had “fallen to levels that were almost 40 percent lower than those for the state as a whole” (Johnson & Hayes, 2004, p. 19). As a result of these income disparities, about 1 in 5 residents in the San Joaquin Valley live in poverty, compared to 13 percent in the rest of California (Public Policy Institute of California, 2006). In some San Joaquin Valley communities, over half of the children live in poverty (Johnson & Hayes, 2004). To make matters worse, in a February 2012 report by the U.S. Bureau of Labor Statistics, all eight counties of the San Joaquin Valley reported unemployment rates well above the national rate of 8.3 percent. The

December 2011 rates reported by the eight counties ranged from 14.5 percent (Kern County) to 18.7 percent (Merced County) (U.S. Bureau of Labor Statistics, 2012).

In pursuing sustainability as a goal, communities in the San Joaquin Valley must focus on the health of their residents. The American Human Development Project states that health is “central to human development” and that “it is the foundational human capability: [as] to live a freely chosen life of value, you must first be alive” (Burd-Sharps & Lewis, 2011, p. 50). Though California as a whole fares well when compared to the rest of the United States in terms of health, progress is uneven. Within the state, life expectancy varies widely from region to region. The average lifespan in the San Joaquin Valley is 77.5, compared to 80.1 for the rest of California (Burd-Sharps & Lewis, 2011). The San Joaquin Valley is especially plagued by poor air quality, specifically its levels of ozone and particulates that harm human health. These particulates can “either exacerbate or trigger heart and lung-related illnesses, such as asthma, bronchitis, and emphysema, particularly among children and older adults” (Burd-Sharps & Lewis, 2011, p. 51). The top three counties with the highest levels of particulates in the country are all located in the San Joaquin Valley: Kern, Fresno, and Tulare. Kern County, the worst in the nation, has a particulate count that is two times what the EPA deems acceptable for human health. Air pollution is also “associated with more heart attacks than more risky behaviors like using cocaine” (Burd-Sharps & Lewis, 2011, p. 51).

Education attainment levels are also depressed when compared to the rest of California. When comparing all the regions of the state, the San Joaquin Valley has the “lowest proportion of college graduates and the highest

proportion of adults who have not completed high school” (Johnson & Hayes, 2004, p. 17). This is evident in the fact that a resident of the San Joaquin Valley is “only about one-third as likely to have graduated from college as one from the Bay Area” (Burd-Sharps & Lewis, 2011, p. 80). In 2000, of the adults in the region age 25 and older, only 14 percent were college graduates, compared to 28 percent in the rest of the state (Public Policy Institute of California, 2006). A staggering number of the Valley’s adults, 28 percent, have not even completed high school, about the same percentage as the nation as a whole more than a quarter century ago (Burd-Sharps & Lewis, 2011). The high unemployment and poverty levels experienced by the San Joaquin Valley are believed to be a direct result of this low level of education attainment.

In addition to the many challenges facing the people of the San Joaquin Valley, if current land-use trends continue, one of the region’s strongest economic drivers, agriculture, will remain threatened by urban sprawl. As of 2000, the eight San Joaquin Valley counties had a total of 5.7 million acres of farmland. Of this farmland, 55.6 percent, or 3.2 million acres, was classified by the state as prime farmland. Prime farmland, as defined by the state, is land that “has the best combination of soil quality, growing season, and water supply and actually was in irrigated agricultural production within four years of the mapping date” (Teitz, Dietzel, & Fullton, 2005, p. 32). Regrettably, due to current unsustainable land-use decisions, the San Joaquin Valley has been losing thousands of acres of farmland, many of them prime farmland, to urban-use development. Though, under land-use scenarios proposed by the Public Policy Institute of California (PPIC), there will most likely be a 15 percent loss (9

percent in the best case scenario) of farmland in the next 30 years due to projected development needs, it is essential for communities in the San Joaquin Valley to strategically plan future land-use decisions to ensure maximum sustainability in the years to come.

METHODS

In searching for the root cause of the San Joaquin Valley's unsustainability, I turned to sources that examine specific cases of sustainability from economic, environmental and social points of view. In her book *Governing the Commons*, Elinor Ostrom takes a political economic approach to analyzing the evolution of institutions for managing common-pool resources. The second book I selected, *Water and Poverty in the Southwest* by F. Lee Brown and Helen Ingram, takes a different approach and analyzes the governing of the commons from a social perspective. I also reviewed *The Environmental Case*, where Judith A. Layzer takes a close look at specific environmental cases from across the nation and analyzes how the communities involved and their residents are affected. Lastly, in *Hope's Horizon*, Chip Ward details the growing disconnect across the United States between the people and their communities as a result of development patterns. While studying these works, I searched for a common theme or trend that might connect the issues related to sustainability and that might help point me in the direction of a single root cause. By recognizing an emerging common theme shared by each of these case studies, I was able to infer a root cause.

RESULTS

After examining the different cases in the four books I selected, it is apparent to me that community empowerment and social sustainability are the basis for

regional sustainability as a whole. In my analysis of the different cases regarding sustainability in the books I selected, the notion of community empowerment became a recurring thread. In each case, some notion of community empowerment proved key in reversing unsustainable practices. Whether the focus is on issues of economic, environmental, or social sustainability, appeals to community knowledge and involvement proved to be a common driving force for sustainability.

In *Governing the Commons*, Elinor Ostrom approaches the issue of common-pool resources from an economic point of view. Ostrom details the problems surrounding the management of these shared resources and offers suggestions on how to keep them sustainable. A common-pool resource (CPR), as defined by Ostrom, is a natural resource used by many individuals in common; examples of CPRs include fisheries, groundwater basins, and irrigation systems. Though two conventional solutions exist to managing CPRs (either centralized government regulation or privatization of the source), Ostrom proposes a more sustainable third approach. This alternative approach to CPR management promotes the design of a durable, cooperative institution that is organized and governed by the resource users themselves, in essence, creating an economically sustainable CPR. Ostrom admits that groups must overcome obstacles in order to self-govern a CPR, including free rider and commitment problems, but that it is possible. Ostrom examines several historical cases of successfully self-governed commons and identifies a specific set of design principles each group contains. Ostrom found that within each community that successfully self-governed its CPRs, most individuals affected by the governing rules can participate in modifying them, rules

governing the use of collective goods are well matched to local needs and conditions, and the rights of community members to devise their own rules is respected by external authorities. Ostrom stresses the survival of self-managed CPRs through local knowledge and involvement (Ostrom, 1990).

This trend of community involvement continued in *Water and Poverty in the Southwest* where the issue of water and its implications are examined through the lens of social sustainability. Pointing to the saying “water flows uphill to money,” the book serves to shine a light on the link between water, viewed as a very high commodity in the arid Southwest, and poverty (Brown & Ingram, 1987, p. 1). Brown and Ingram outline the effects of the West’s development period over the last 100 years on the rural poor. During this time, new values were imposed upon the land without the consultation of those native to the area. Unfortunately, the new values and rapid development that the rural poor were subjected to often proved harmful to their interests. Brown and Ingram go on to explain that it is for these reasons that even perceived threats to their water interests can result in a strong reaction. With this knowledge, Brown and Ingram explain how the emotion-laden issue of water policies can serve as a catalyst for political involvement (Brown & Ingram, 1987). *Water and Poverty in the Southwest* exemplifies the negative impacts communities can sustain when not involved in decisions that affect them.

In her book, *The Environmental Case*, Judith A. Layzer analyzes a number of cases from across the nation pertaining to all aspects of sustainability. In one particular case study concerning the revitalization of the Dudley Street neighborhood in Boston, the trend of community empowerment continues when

Layzer stresses the importance and necessity of community involvement. Though the Dudley Street neighborhood “was once the location of wealthy Bostonian’s country estates, by the 1800’s the area [...] had become a thriving working-class immigrant community,” and by the 1980’s had become “a classic example of a blighted inner-city neighborhood with few prospects for renewal (Layzer, 2006, p. 108). In response, the City of Boston created the Dudley Street Neighborhood Initiative, which was tasked with reversing the neighborhood’s devastation by utilizing a citizen-led urban revitalization (Layzer, 2006). Layzer explains that, often times, communities of people in these situations are very wary of any outsiders coming in and trying to take control of the situation as they see any engagements from the outside, no matter how good the intentions, to be threatening. In order to combat this notion, Layzer identifies the key to success as the ability to maintain a strong trust with the community whom is being helped (Layzer, 2006).

The trend linking community involvement and sustainability continues in the first two sections of Chip Ward’s book, *Hope’s Horizon*, as he outlines the disconnect created between people and the land as a result of development patterns. In the first section titled “Restoration,” Ward discusses the problems faced with the loss of biodiversity. Ward traveled and met with an array of different citizens and leaders of local grassroots organizations across the country to gather data on specific habitats and creatures that people want to conserve and understand. On his journey Ward identified the key to combating this loss of biodiversity was the engagement of local citizens. By enlisting volunteers from the community in the efforts against the loss of biodiversity,

members of the community learned first hand of the negative impacts the loss of biodiversity can have. In the second section, "Reconnection," outlines the efforts of Zach Frankel, founder of the Utah Rivers Council. In the Utah River Council's quest to preserve wetland ecosystems, Zach reiterates the group's strategy that proved essential for furthering their agenda: spreading awareness by educating the communities most impacted.

This idea of community empowerment as a key tenet of social sustainability was the key idea that appeared in each case I examined. Without social sustainability, there would exist no platform to build upon and achieve either economic or environmental sustainability.

DISCUSSION

As was the case with the rural communities outlined in Elinor Ostrom's *Governing the Commons*, the urban development policies experienced by the San Joaquin Valley over the last century brought with them the application of new values and, as a result, created a disconnect between the people of the San Joaquin Valley and their communities. With this understanding of how the San Joaquin Valley became the most challenged region in the nation over the course of the last century, it is imperative to now focus on finding strategies for reversing the Valley's unsustainable practices.

Using the knowledge that social sustainability is the basis for economic and environmental sustainability (in other words, sustainable communities as a whole), the San Joaquin Valley is charged with implementing new programs and policies that seek social sustainability. By creating and promoting policies that support social sustainability initiatives, the

San Joaquin Valley will be able to create sustainable communities that are able to provide for the needs and well-being of their residents.

Knowledge is power. Consequently, it is a key component for empowering the community and getting residents involved in the decisions that affect them. Asian American Pacific Islanders (AAPIs), for example, have strong agricultural ties to and played an important role in the settling of the San Joaquin Valley, though are disproportionately affected by the challenges faced by those in the Valley (Great Valley, 2010). For the most part, this has been a direct result of the disconnect created by rapid population growth, development, and the subsequent new values which were imposed upon the communities. The AAPI community is the second fastest growing ethnic population in California, and with one-third of the nation's AAPI population living in California and two-thirds of them born overseas, they easily identify with the other minority communities of the San Joaquin Valley (Burd-Sharps & Lewis, 2011). Unfortunately, the most disadvantaged of these minority communities tend to be unfamiliar with the language and unable to effectively address the issues that are affecting them. For this reason, it is important that the communities of the San Joaquin Valley do everything in their power to promote social sustainability in order to effectively create sustainable communities.

According to President Clinton's Council on Sustainable Development, "a community's ability to learn will, in part, determine the degree to which it will flourish or languish" (The President's Council on Sustainable Development, 1999, p. 70). Because of this, "knowledge creation through information and technical assistance is an indispensable element of

sustainable community development” (The President's Council on Sustainable Development, 1999, p. 70). There are a number of strategies that communities in the San Joaquin Valley can utilize in an effort to achieve social sustainability. The first of these includes increasing public education on sustainability in order to raise awareness not only within the community, but for decision makers as well “on challenges of and opportunities for sustainable community development and to make a persuasive and credible case for action” (The President's Council on Sustainable Development, 1999, p. 70). Second, by creating learning networks and technical assistance, it is possible to “institutionalize knowledge and build local capacity for recognizing and solving problems, and for identifying and refining sustainable strategies” (The President's Council on Sustainable Development, 1999, p. 70). A third key strategy for social sustainability is providing communities with “accessible and user-friendly information and data that [is] relevant to sustainable community concerns and can demonstrate the connections between the economy, the environment, and equity” (The President's Council on Sustainable Development, 1999, p. 70). Furthermore, improved analytical tools and methods are necessary to enable better problem solving, planning, and decision-making. Lastly, self-explanatory, concise, clear indicators and performance measures are necessary so the community is able to track performance toward desired goals (The President's Council on Sustainable Development, 1999).

By offering programs that clearly define and lay out what's at stake, and by educating the community on how to get involved, communities will be able to

effectively put power into the hands of their citizens. It is with this active community involvement that real solutions will be able to form to real issues in the community. Only once social sustainability has been achieved will communities be able to effectively pursue sustainable environmental and economic policies that, together, strive to create a complete, sustainable community.

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Analysis of Conformational Influences Within (2*R*,3*R*)-butanediol

Zoila M. Estrada

Abstract

(2,3)-Butanediol is a simple polyol with two different isomers: the meso isomer and the racemic isomer. We examined (2*R*, 3*R*)-butanediol in different solvents and investigated its conformational preferences to determine the conformational influences present in (2*R*,3*R*)-butanediol. (2*R*,3*R*)-butanediol serves as a model molecule to understand the conformational influences in more complex compounds such as proteins. Some conformational influences we investigated are steric bulk, intramolecular hydrogen bonding, Coulombic attraction/repulsion, solvent effects, the polarity of the conformer versus polarity of the solvent, and hyperconjugation. This project primarily aimed to understand possible occurrence and effect of hyperconjugation between vicinal hydroxyl (OH) groups, which are present in (2*R*, 3*R*)-butanediol. Hyperconjugation is an interaction between sigma bond electrons and a vicinal, coplanar anti-bonding sigma orbital, which is thought to increase the stability of the system. The methodology employed was ¹H NMR and ¹³C NMR on (2*R*, 3*R*)-butanediol in different solvents. Then we simulated the experimental spectrum on gNMR to extract the coupling constants. We used the Altona equation in order to correlate the coupling constants with dihedral angles, thereby determining the conformation of the compound.

INTRODUCTION

Importance & Application

By investigating the solvent effects within (2*R*, 3*R*)-butanediol we are aiming to discern the conformational preferences within this molecule. We hope to make this molecule a model molecule to help us understand the conformations of larger

molecules such as proteins. Proteins in the body contain numerous amino acids in their peptide chain. These acids fold from the primary structure up to the quaternary structure due to the intramolecular conformational influences among the amino acids:

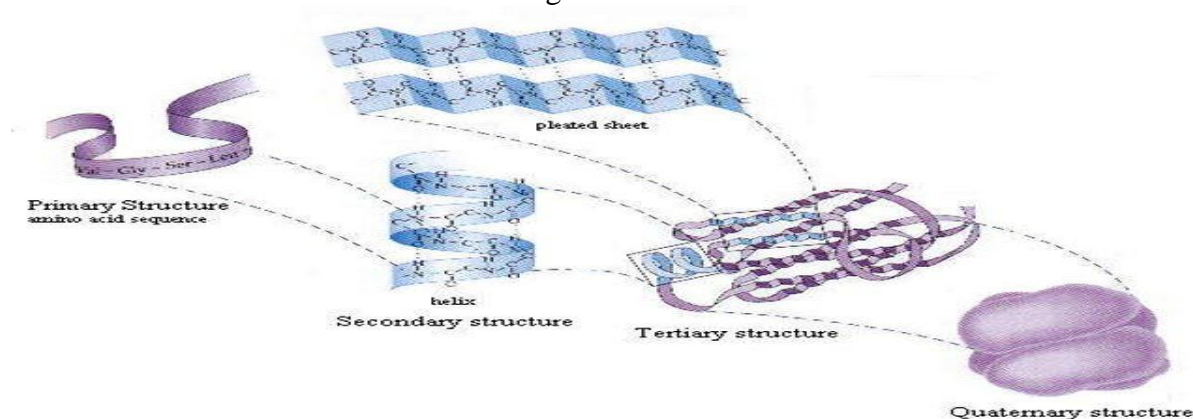


Figure 1: Proteins undergo four different structures, which fold through intramolecular and intermolecular bonding. The hydrogen bonding is a conformational influence that we study.

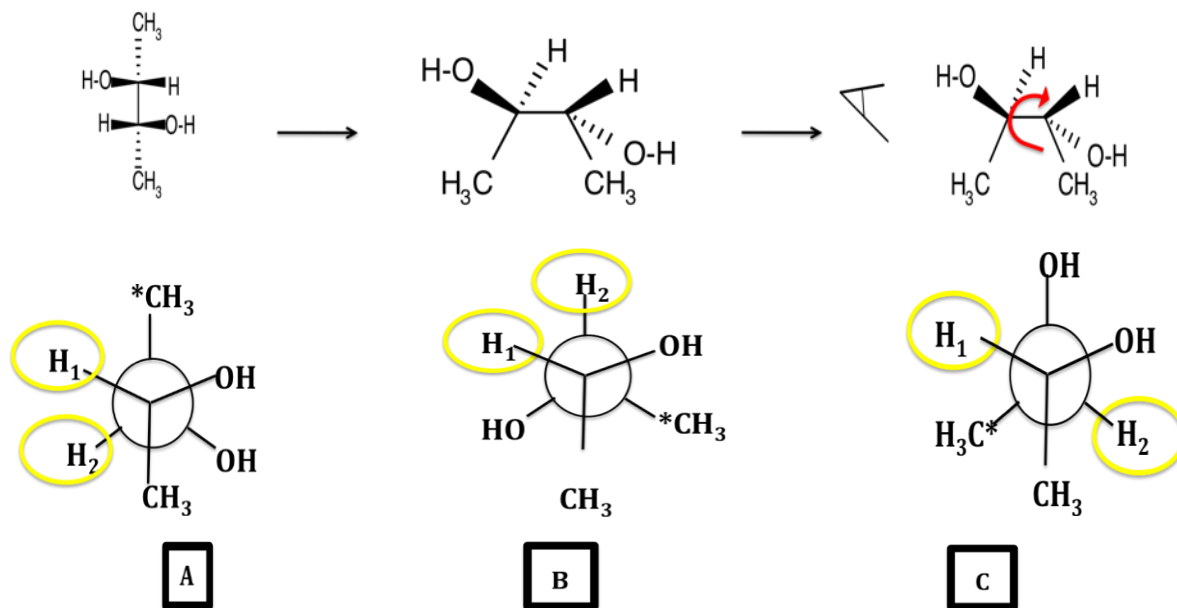


Figure 2: The three conformational isomers of (2R, 3R)-butanediol.

Some conformational preferences outlined in this study are steric bulk, intramolecular hydrogen bonding, Coulombic attraction/

repulsion, solvent effects, the polarity of the conformer versus polarity of the solvent, and hyperconjugation.

Conformational Influences & Predictions

Steric Bulk

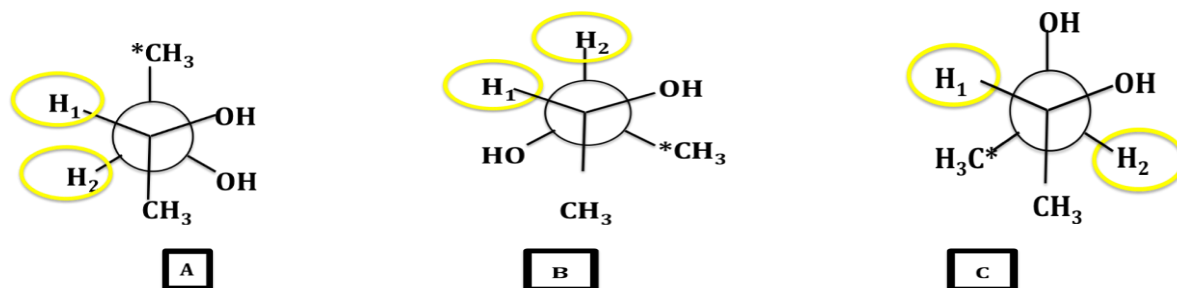


Figure 3: The three conformational isomers of (2R, 3R)-butanediol.

(2R,3R)-butanediol has two types of substituents: the hydroxyl and the methyl groups. The methyl groups will repel each other due to their size. Therefore, since the isomer A has an anti-methyl conformation it is expected to relieve the steric strain of the two methyl groups. Both isomer B and C have the methyl groups in close proximity, and are expected to exhibit more steric strain.

Hydrogen Bonding

All three conformational isomers could possibly exhibit intramolecular hydrogen bonding interactions because they all have vicinal hydroxyl groups. Also, all three isomers may exhibit intermolecular hydrogen bonding with a solvent that allows for this dipole-dipole interaction. Both isomer A and

C have a higher likelihood intramolecular hydrogen bonding because the vicinal hydroxyl groups are gauche.

Coulombic Attraction & Repulsion

The charge attraction or repulsion may occur with the vicinal hydroxyl groups. The hydroxyl groups have the lone pair electrons; therefore, repulsion may occur. Both isomer A and C have the hydroxyl group in close proximity coulombic repulsion between OH groups in A and B would be greater than C. In effect, isomer B has the hydroxyl groups anti to each other; it will be the most stable conformation based purely on the repulsion of OH groups.

Polarity of the Conformer Versus the Polarity of the Solvent

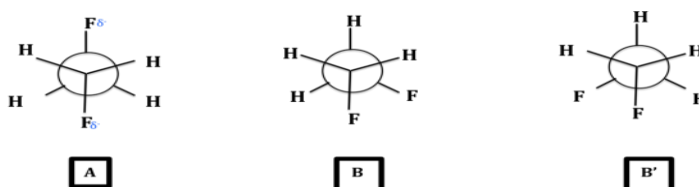


Figure 4: The Three Conformational Isomers of 1,2-Difluoroethane. B and B' are the same

1,2-difluoroethane demonstrates excellent hyperconjugation interactions as illustrated in Figure 5. The electron donation from the σ_{CH} to the σ^*_{CF} illustrates a smooth transition of electrons because the sigma and σ^* bonds are coplanar. Therefore, the donation of electrons has the possibility of occurring. Since the electronegativity of

The polarity of the conformer is due to the diols on rac-2,3-butanediol. This makes the molecule more susceptible to interacting better with very polar solvents such as D_2O versus p-dioxane.

Hyperconjugation

We investigated the presence of hyperconjugation as a means toward the stabilization of a molecule. We will later examine a theoretical study where hyperconjugation was observed, but with (2R,3R)-butanediol we wanted to investigate it at the experimental level. In 2005, Goodman, Gu, and Pophrastic studied the effect of hyperconjugation in 1,2-difluoroethane.

fluorine is the highest, the $C-F \sigma^*$ orbital is a better electron acceptor than the $C-H \sigma^*$ orbital. On the other hand, the $C-H \sigma$ orbital is a better electron donor than the $C-F \sigma$ orbital. A good overlap between the better donor and the better acceptor is only conformation the gauche conformation provides.

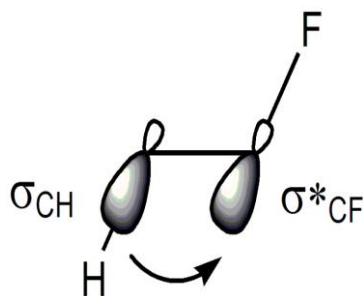


Figure 5: A model illustrating Hyperconjugation in 1,2-difluoroethane

Goodman demonstrated that when C_1-H/C_2-F^* hyperconjugation interactions are removed, the molecule is the most stable when the vicinal F are 180° (the anti conformation). The dark line in Figure 6 shows this. Goodman then demonstrated that 1,2-difluoroethane was at its most stable (F/F

dihedral; 60° and 270° , gauche conformation) when the C_1-H/C_2-F^* hyperconjugation interactions were retained in the theoretical calculation indicated by the dashed line in figure 6. This effect they called the gauche effect.

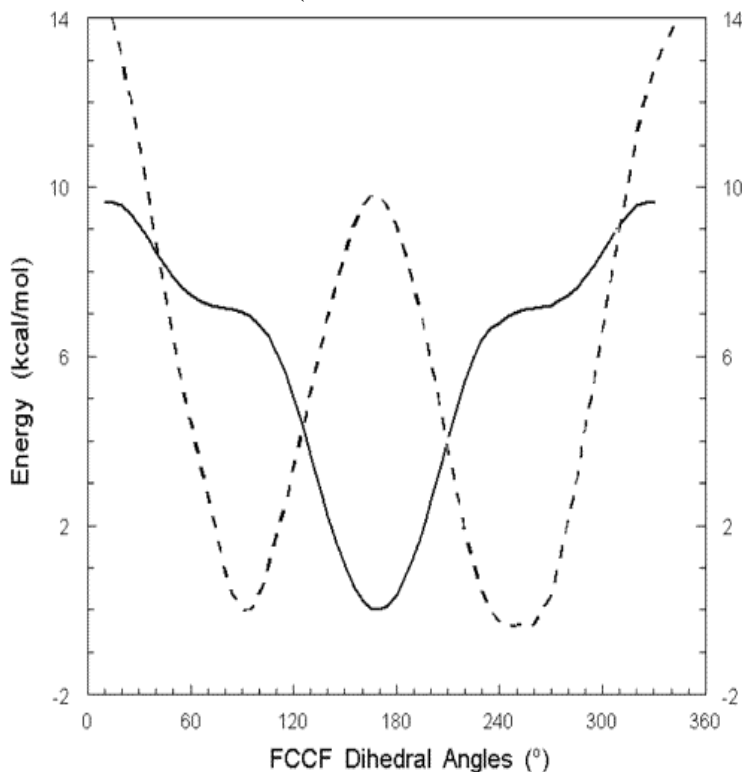


Figure 6: It depicts the fully optimized potential curves obtained: when only the C_1-H/C_2-F^* interactions are removed (—); when only the C_1-H/C_2-F^* interactions are retained with all other interactions expunged (---). Energy zero is arbitrarily taken at minimum of (---) curve.

In racemic-2,3-butanediol, we have two excellent hyperconjugation interactions within isomer A and C as illustrated in Figure. 7 and 9. Hyperconjugation in B is lacking for the

sigma to the anti-sigma electron donation is not coplanar. The expected percentages of A and C is much higher than B.

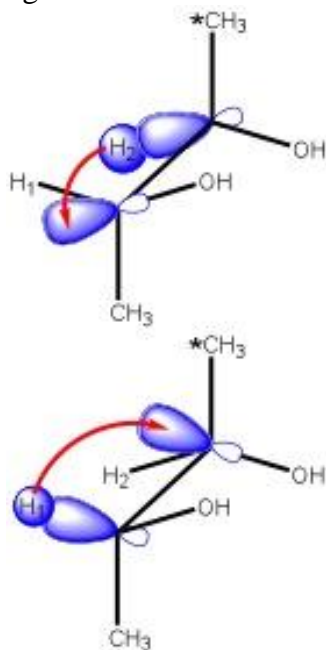


Figure 7: Conformer A

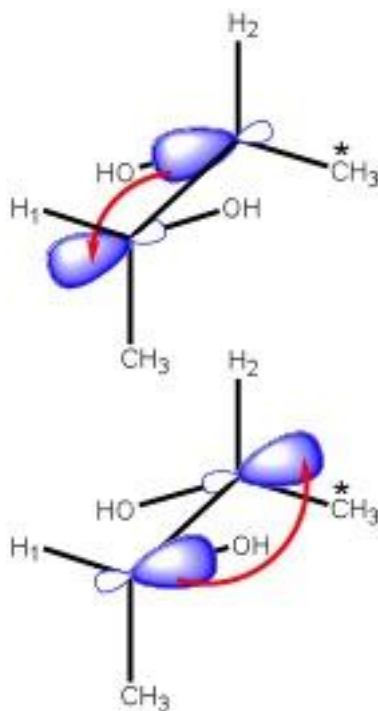


Figure 8: Conformer B

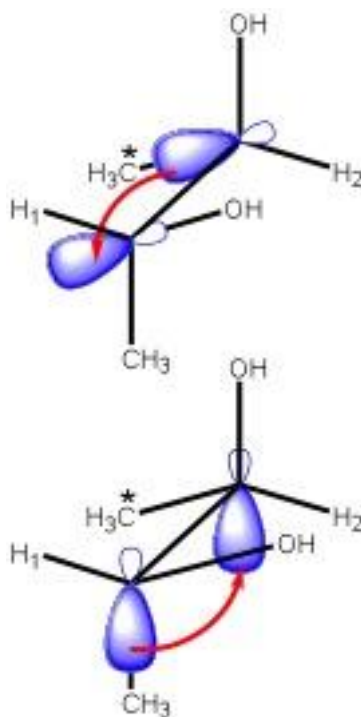


Figure 9: Conformer C

PREVIOUS RESEARCH

1. ^1H NMR Acquired

Previous research students acquired proton NMR to extract the coupling constants from the experimental spectrum. In effect, the

coupling constants acquired would later be used to calculate the percentage of each conformational isomer through the Altona equation.

Table 1: ^1H NMR acquired by previous research students for (2R, 3R)-butanediol

solvent	$J_{5.7}/J_{10.9}$	$J_{5.6}/J_{10.8}$	$J_{5.9}/J_{10.7}$	$J_{6.7}/J_{8.9}$	$J_{6.9}/J_{8.7}$	$J_{7.9}$
D₂O	6.45	not obs.	-0.30	not obs.	not obs.	5.96
methanol-<i>d</i>₄	6.41	not obs.	-0.29	not obs.	not obs.	5.84
ethanol-<i>d</i>₆	6.41	not obs.	-0.32	not obs.	not obs.	5.87
isopropyl alcohol-<i>d</i>₈	6.36	not obs.	-0.31	not obs.	not obs.	6.04
t-butyl alcohol-<i>d</i>₁₀	6.35	not obs.	-0.21	not obs.	not obs.	6.39
DMSO-<i>d</i>₆	6.31	0.01	-0.05	4.73	-0.29	5.52
acetone-<i>d</i>₆	6.41	-0.03	-0.27	4.15	-0.27	6.02
acetonitrile-<i>d</i>₃	7.47	0.01	-0.11	6.27	-0.57	2.39
p-dioxane-<i>d</i>₈	6.15	-0.03	-0.44	4.25	-0.34	5.96

PROBLEMS

2,3-Butanediol has two isomers: the meso and the racemic isomer. The meso isomer's conformational preferences may be calculated using the Altona equation (described in **Problems**) because two of the

three conformations are the same energy. Therefore, we have three unknowns (%A, %B, %B') and three equations relating %A, %B, and %B' (Figure 11). This is illustrated by the Newman projections of B and B' on meso-2,3-butanediol.

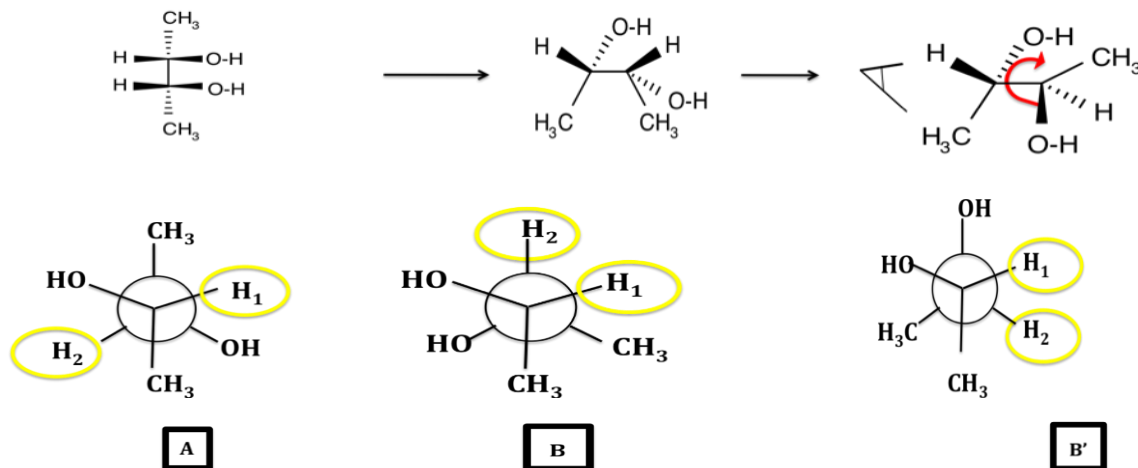


Figure 11: Meso-2,3-butanediol

Unknown: $F_A, F_B, F_{B'}$

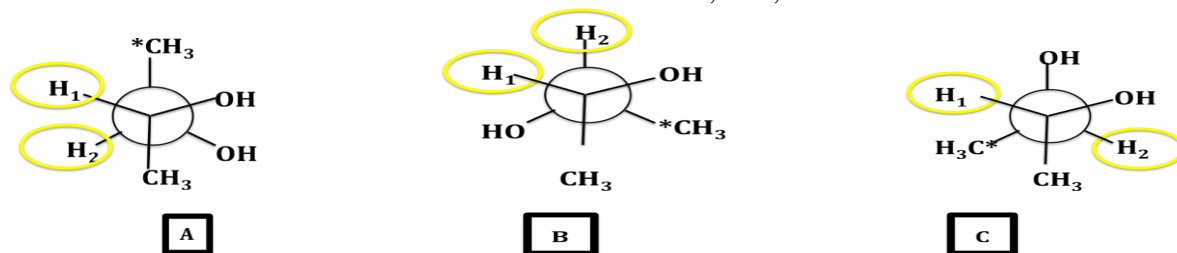
$$J_{12} = (F_A)(J_{12A}) + (F_B)(J_{12B}) + (F_{B'})(J_{12B'})$$

$$F_A + F_B + F_{B'} = 1$$

$$F_B = F_{B'}$$

However, in racemic-2,3-butanediol the situation becomes more complicated because we have three distinct conformers with three

different variables (%A, %B, %C), but only two equations to relate ¹H-¹H J-values with %A, %B, and %C.



Unknown: F_A, F_B, F_C

$$J_{12} = (F_A)(J_{12A}) + (F_B)(J_{12B}) + (F_C)(J_{12C})$$

$$F_A + F_B + F_C = 1$$

$$J_{H_1C_{obs}} = (F_A)(J_{12C}) + (F_B)(J_{12HC}) + (F_C)(J_{12HC})$$

CURRENT RESEARCH

¹³C NMR

We used ¹³C NMR spectroscopy to gather an experimental spectrum. Then, we simulated this experimental spectrum on gNMR to extract the coupling constants. The coupling constants will be used in the Altona equation

to calculate the percentage of each conformer. In effect, we need a J_{C-H} . Therefore, through extensive literature review, we are in search of a method by which to relate ¹³C-¹H coupling constants to dihedral angles.

EXPERIMENTAL DETAILS AND RESULTS

Masses and Volume acquired for deuterated solvents

Table 2: Mass and Volume of Solvent and (2R,3R)-butanediol

Solvent	Mass of (2R, 3R)-butanediol (g)	Volume (mL)
methanol- <i>d</i> ₄	0.0270	0.40
DMSO- <i>d</i> ₆	0.0610	0.40
acetone- <i>d</i> ₆	0.1146	0.40
acetonitrile- <i>d</i> ₃	0.1000	0.40

NMR Acquisition

Table 3: NMR acquisition variations for (2R, 3R)-butanediol

Solvent	Boiling Point (°C)	Temperature (°C)	Number of Scans	# of x-points
methanol- <i>d</i> ₄	64.7	50	8500	64000
DMSO- <i>d</i> ₆	189	50	5000	64000
acetone- <i>d</i> ₆	56.5	50	32000	64000
acetonitrile- <i>d</i> ₃	81.6	50	32000	64000

We varied the temperature (not exceeding the boiling point of the solvent) for the experimental spectrum. In effect, we had to elevate the temperature to receive better resolution of the spectra. We needed excellent resolution in order to see if certain peaks existed or what we observed was just noise from the machine. For the most part, all the solvents used had an elevated temperature of 50°C.

Some solvents needed more scans than others. The solvents that needed less scans tended to

lose their lock signal after a certain time like methanol-*d*₄ and DMSO-*d*₆.

The number of x-points used was consistently 64000. 32000 x-points were utilized initially; however, it was not giving the resolution needed for a proper experimental spectrum.

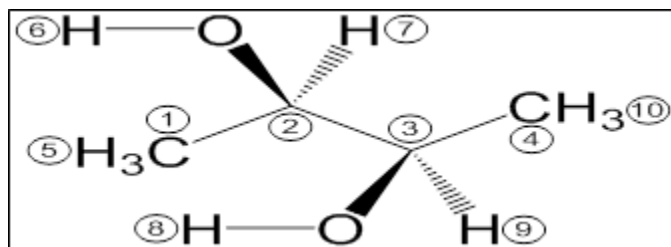
gNMR

We used gNMR to simulate the experimental spectrum. This software calculates the coupling constants of the spectrum.

Some samples underwent “D” and “H” exchange. This exchange occurs when covalently bonded O-H hydrogen exchanges with the deuterium atoms of the solvent.

Therefore, some solvents such as D₂O, methanol, ethanol, isopropyl alcohol, t-butyl alcohol do not have observed “OH” coupling constants.

Table 4: ¹³C NMR coupling constants (Hz) for (2R, 3R)-butanediol



Solvent	chemical shifts (ppm)				
	1/4	2/3	5/10	6/8	7/9
D ₂ O	19.422	73.146	1.129	not obs.	3.610
methanol- <i>d</i> ₄	18.924	72.895	1.112	not obs.	3.511
DMSO- <i>d</i> ₆	18.255	70.510	0.962	4.294	3.379
acetone- <i>d</i> ₆	19.086	72.272	1.073	3.538	3.437
acetonitrile- <i>d</i> ₃	19.898	73.152	1.052	2.859	3.437

Solvent	J_{1-5}/J_{4-10}	J_{1-7}/J_{4-9}	J_{1-9}/J_{4-7}	J_{1-10}/J_{4-5}	J_{1-6}/J_{4-8}	J_{1-8}/J_{4-6}	J_{2-7}/J_{3-9}	J_{2-10}/J_{3-5}
D₂O	126.14	-1.99	1.99	0.28	not obs.	not obs.	142.85	4.49
methanol-<i>d</i>₄	125.6	-1.29	2.35	0.21	not obs.	not obs.	141.02	4.4
DMSO-<i>d</i>₆	125.16	-0.19	1.36	0	not obs.	not obs.	139.84	4.34
acetone-<i>d</i>₆	125.34	-1.24	0.67	0	not obs.	not obs.	140.96	4.47
acetonitrile-<i>d</i>₃	125.71	-0.51	0.35	0	not obs.	not obs.	141.44	4.51

Solvent	J_{2-5}/J_{3-10}	J_{2-6}/J_{3-8}	J_{2-8}/J_{3-6}	J_{2-9}/J_{3-7}	J_{2-10}/J_{3-5}
D₂O	-4.50	not obs.	not obs.	-2.29	4.49
methanol-<i>d</i>₄	-4.40	not obs.	not obs.	-2.02	4.40
DMSO-<i>d</i>₆	-4.34	not obs.	not obs.	-2.37	4.34
acetone-<i>d</i>₆	-4.47	not obs.	not obs.	-2.26	4.47
acetonitrile-<i>d</i>₃	-4.51	not obs.	not obs.	-2.19	4.51

DISCUSSION

Success

About half of the solvents for carbon NMR have been finished. The difficulty lies in finishing the remaining solvents, which do not undergo "D" and "H" exchange because the added OH coupling further complicates the situation.

I finished the ^{13}C NMR experimental and modeled spectra for methanol, acetone, D_2O (gNMR), DMSO, and acetonitrile (experimental).

Failures

In recent experimental trials, the NMR machine needed to be properly tuned for the carbon nuclei. Deuterated ethanol was not locking to the signal. So, I was having huge shimming issues. It would take approximately two hours to shim my

spectrum well enough to obtain a decent spectrum.

In addition, the modeled spectra for deuterated acetonitrile in gNMR had some alignment issues. Therefore, the proton NMR was retaken. However, the new spectrum was giving excellent resolution that the software simulation was having difficulty calculating.

Literature Review

We are looking for a way to correlate the carbon-proton coupling constants to calculate the percentages of each conformational isomer using the Altona equation.

Aydin R., Günther H. pointed out a well-established equation for carbon-proton coupling: Research is conducted to find where this was established and how the coupling constants are applied.

$${}^nJ(^{13}\text{C}, ^1\text{H}) = (y_{\text{H}}/y_{\text{D}}) J(^{13}\text{C}, ^2\text{H}) / 6.5144^n J(^{13}\text{C}, ^2\text{H})$$

FUTURE RESEARCH

I will continue to collect data on the remaining solvents which are p-dioxane,

ethanol, t-butyl alcohol, isopropyl alcohol, and the gNMR for acetonitrile. Also, I will continue to search for a method that relates ^{13}C - ^1H coupling constants to dihedral angles.

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EXPOSURES

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